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INSTRUMENTS

INDUSTRIAL — SCIENTIFIC

Devoted to the Instrument Problems of all Industries

Vol. 1 No. 11 Pittsburgh, Pa. November, 1928

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The Care of Electrical Instruments
E. S. LINCOLN, NEW YORK, N. Y.

Integration of Diagrams
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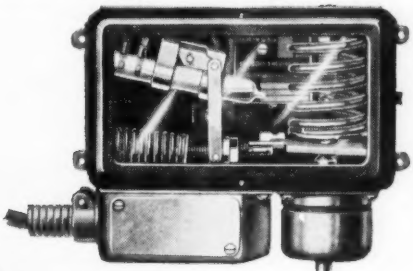

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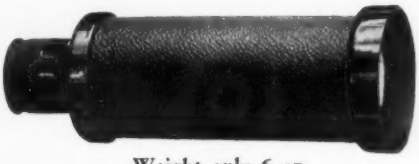

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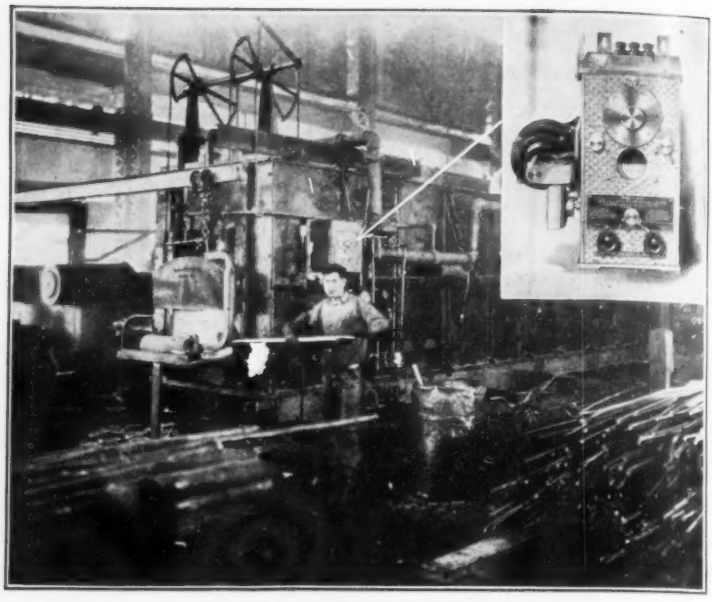
Have your stenographer cut out and file the 3 x 5 cards found bound in the back of this issue, listing the principal articles. They will direct you to valuable information to which you may wish to refer in the future.



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INSTRUMENTS

INDUSTRIAL — SCIENTIFIC

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Vol. 1 No. 11 NOVEMBER, 1928 Pittsburgh, Pa.

To Our Readers

There is no industry that would not profit enormously by measurement, testing, inspection and control of materials as received and during the manufacturing process. For a company to take a lead in the production of quality goods, it must in a large measure depend upon the quality of the materials used and the methods of working them.

The editor is convinced that measurement, testing, inspection and control are of decisive importance for economical quality production, and appeals to those who recognize this, to actively help in the work which INSTRUMENTS has started.

The instrument companies are at present discussing publicity plans for 1929 and are therefore weighing the advantages of a number of publications as advertising mediums. Their decision will be very materially influenced by many factors, the most important of which is "To what publication do our customers look for their information on instruments and devices for measurement, inspection and control."

You will be doing the instrument companies a valuable service, if you will write to those with whom you do business advising them as to what publications you look for instrument information.

The editor trusts that you will follow the above suggestion and assures you that your co-operation will be appreciated.

——— :: ———

New Collaborators

That INSTRUMENTS is filling a very definite need is certain, not only by the extraordinary interest which has been aroused since the first issue was published in January of this year, but also by the willingness of engineers and scientists to assist the editor in every way possible.

We take this opportunity to announce the addition of three new names to the list of collaborators—

Dr. W. G. Brombacher, Chief, Aeronautic Instruments Section, United States Bureau of Standards, Washington, D. C.

Dr. A. V. De Forest, Research Engineer, American Chain Company, Bridgeport, Conn.

Dr. Albert Parsons Sachs, Consulting Chemical Engineer, New York, N. Y.

The Determination of Flashpoint of Paints, Varnishes, Etc.

THIS is the first of a series of articles by H. L. Hazeltine, Engineer of Insulation for The Sterling Varnish Company, Haysville (suburb of Pittsburgh), Penna. Readers of INSTRUMENTS wishing further data on Flashpoint should write to the Editor of INSTRUMENTS who will refer their inquiries to Mr. Hazeltine. Other subjects will be dealt with in further articles and suggestions from the readers will be welcome.

——— :: ———

Integration of Diagrams

In the case of recording flow meters for which the movement of the pen is proportional to the "orifice-head" or to some other differential pressure which is proportional to the square of the flow, it is often a matter of doubt as to whether too much error will be involved by assuming that the mean flow is proportional to the square root of the mean head shown on the diagram; which mean head can easily be obtained by using an ordinary "area-measuring" or "radial" planimeter. Actually the true flow is proportional to the mean of the square roots of the heads so that the error involved depends upon the ratio of this quantity to the square root of the mean head.

In the present article this error is evaluated for various types of diagram for the first time, and a general rule is derived which enables one to see at a glance whether a diagram can be integrated directly by means of an ordinary planimeter, or whether it must first be replotted on a flow basis or integrated by means of a special square-rooting planimeter.

In a later article Mr. Hodgson will describe two square-rooting planimeters which enable the mean of the square root of the "heads" to be obtained.

——— :: ———

Correction—Transverse Tests on Round and Square Bars of Grey Cast Iron.

THERE was an error in the article on Transverse Tests on Round and Square Bars of Grey Cast Iron published in the September issue of INSTRUMENTS. The transverse formulae should read:

$$\frac{W.l.}{4} \cdot \frac{32}{\pi d^3} = \frac{W.l.}{0.392\, d^3} \quad \text{for round bars}$$

$$\frac{W.l.}{4} \cdot \frac{6}{a^3} = \frac{1.5\ W.l}{a^3} \quad \text{for square bars}$$

Where W = breaking load in tons
l = length between supports
d = diameter of bar
a = length of side of bar

The correct formulae were used in calculating the results.

The Measurement of Temperature

THE following is taken from a letter received from Captain M. F. Béhar, Advertising Manager, C. J. Tagliabue Mfg. Co.:

The article on the measurement of temperature is excellent. It gives more practical dope than does the article on Thermometry in the thirteenth edition of the Encyclopedia Britannica and it does so in about one-tenth of the wordage. . . . . Now in the "classification of industrial temperature measuring instruments" you group the vapor-tension instruments together with the liquid-in-glass, under "expansion of liquids." This is open to objection. Of course, each company and in fact each investigator may arrive at a classification unlike the others, but here is one that I have worked out for myself:

INDUSTRIAL TEMPERATURE MEASUREMENT
Part One—Indicating Instruments

I. Below 900° F.—(Indicating Thermometers)
  1. Liquid-in-Glass (Visible Column)
    a. Mercury
      1. Etched Stem ("Laboratory" or "Chemical")
      2. "Industrial"
      3. "Miscellaneous" (Pocket, wall, etc.)
    b. "Spirit" (1, 2 and 3 as above)
  2. Pressure Spring
    a. Mercury
      1. Non-compensated
      2. Head-compensated
      3. Fully-compensated
    b. Vapor Tension
      1. Progressive Scale
      2. Uniform Scale
    c. Gas
  3. Solid Expansion
    a. Bi-Metallic
    b. Metal and Refractory
  4. Electrical Resistance
    a. Nickel
    b. Platinum

II. Above 900°F. (Indicating Pyrometers)
  1. Thermo-electrical
    a. Galvanometric
    b. Potentiometric
    c. Semi-Potentiometric
  2. Optical
  3. Radiation

Note that the above only refers to the indicating temperature instruments. For recording temperature instruments I would have a slightly different method of classification. I have given a great deal of thought to this and have tried to make a classification which is logical from the industrial standpoint—satisfying the manufacturers and users of industrial temperature instruments and not the scientific laboratory worker. Reconciliation is absolutely impossible between these two standpoints.

——— :: ———

The C. J. Tagliabue Mfg. Company have installed a 600 ton forging press to form brass parts of their instruments now produced by casting. This press is the largest press ever to be installed in Metropolitan New York, and is also the largest ever to be installed by an instrument manufacturer.

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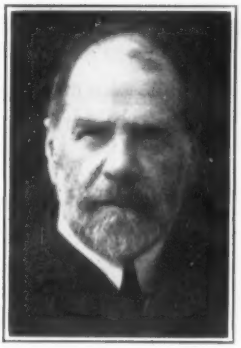
Instrument Pioneers

Sir Horace Darwin
(1851-1928)



HORACE DARWIN was born at Down, England, on May 13, 1851, and was the fifth son of Charles and Emma Darwin. He was educated at Trinity College, Cambridge, matriculating in 1874.

After taking his degree, he served his apprenticeship at Easton and Anderson, Engineers. During this time he designed his first scientific instrument, a klinostat, for recording the rate of growth of small plants. He built the instrument himself with the aid of the company pattern maker, and it was used for many years by his brother, Francis Darwin, in the Botanical Laboratory at Cambridge.

On his return to Cambridge, he produced in conjunction with A. G. Dew-Smith the instruments for the new Physiology Laboratory at the University. A little later Darwin designed for his cousin, Francis Galton the anthropometric instruments with which so much of Galton's work was performed. With his brother, George Darwin, he designed the bifilar pendulum form of seismograph for recording very small seismic disturbances. All his life he was interested in seismological work, and for many years was a member of the Seismological Committee of the British Association. The rocking microtome was also developed by him at this time.

The partnership with Dew-Smith lasted for ten years, and then they separated, Dew-Smith retiring, and Darwin retaining the instrument-making business. This was organized into a company in 1895 as the Cambridge Scientific Instrument Company, Ltd.

About 1895 Darwin became interested in the local government of Cambridge, and was Mayor for the year 1896-97. For some years he was a director of the Cambridge Gas Company, and took a leading part in the introduction of modern equipment. He was a member of the Board of Electors to the Professorship of Engineering and took great pride and interest in the growth of the Engineering school. He was elected a Fellow of the Royal Society of London in 1903.

A few years before the outbreak of the war he was made a member of the Advisory Committee on Aeronautics, appointed to advise the British Government what researches should be made to develop the

science of flight. Darwin regarded it as his special province to design the instruments required to study the behavior of aircraft in flight. The war brought him the greatest sorrow of his life in the death of his only son, Erasmus, who was killed in April, 1915.

He devoted all his energies to designing instruments for the new conditions introduced by air warfare: height-finders and methods of locating aircraft to meet attack by the air, gun sights, etc. In 1917 he was made chairman of the Air Inventions Committee. For his services on this committee he was made a Knight Commander of the Order of the British Empire in 1918.

Darwin's influence will be most lastingly felt in the improvements he introduced into the design and construction of scientific instruments. There is no doubt that he had a unique genius in the creative design of new instruments.

Although during recent years increasing ill-health made it impossible for him to visit the factory regularly, yet he kept in touch with any important developments in the business, and was always ready to help with his advice. He died on September 22, 1928.

He married the Hon. Emma Cecilia Farrer, daughter of Lord Farrer, in 1880. They had two daughters, Emma and Ruth, and one son.

———— :: ————

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The Determination of Flashpoint of Varnishes, Paints, Etc.

*H. L. Hazeltine**

FLASHPOINT is a term that is so continually used in industry that one would expect that there would be no difference of opinion in its application. It seems, however, to be the sort of word that all understand in a general way but few take the trouble to examine into its exact meaning with the result that two people can rarely discuss it with the assurance that they are speaking in one another's vernacular.

It is an important term to industry. Sometimes it determines a freight or ocean rate of transportation. Sometimes it has an effect upon insurance rates. Very often it is ignored as being "too technical" whereas as a matter of fact safety depends upon an intelligent interpretation of it and its relation to certain commodities.

Flashpoint is defined as that temperature at which vapors are given off from an inflammable substance in such quantity that when mixed with air they may be ignited with a flame but will not continue to burn of themselves. This should not be confused with fire point which is the temperature at which these volatile gases will continue to burn when the flame has been withdrawn.

"This material shall not flash at 70°F." is often used in writing a specification. What is meant is in effect, "If this material is exposed to the atmosphere there will be no danger of its vapors igniting should there be an unprotected flame in the immediate vicinity."

So far as paints and varnishes are concerned there is no danger of their flashing when they are in closed containers but there is *always* danger when these containers are left open near a flame. Flashpoint then derives its importance from the fact that by its measurement the behavior of these materials may be predicted when they are exposed to certain conditions.

Since flashpoint is defined in terms of the rate of evaporation of volatile matter its value will vary with the quantity of liquid, the area of the exposed surface, the rate of temperature rise, the heat conductivity and thickness of the container, the size of flame and its distance from the commodity's exposed surface. In designing a test therefore these factors must be taken into consideration and safeguards must be outlined to eliminate as far as possible the personal equation.

This has been done in the case of the two instruments that are in common commercial use—the Open Cup and the Closed Cup. As the results obtained are not the same, care should be taken in writing specifications to indicate the method employed.

*Engineer of Insulation, Sterling Varnish Co., Haysville, Pa.

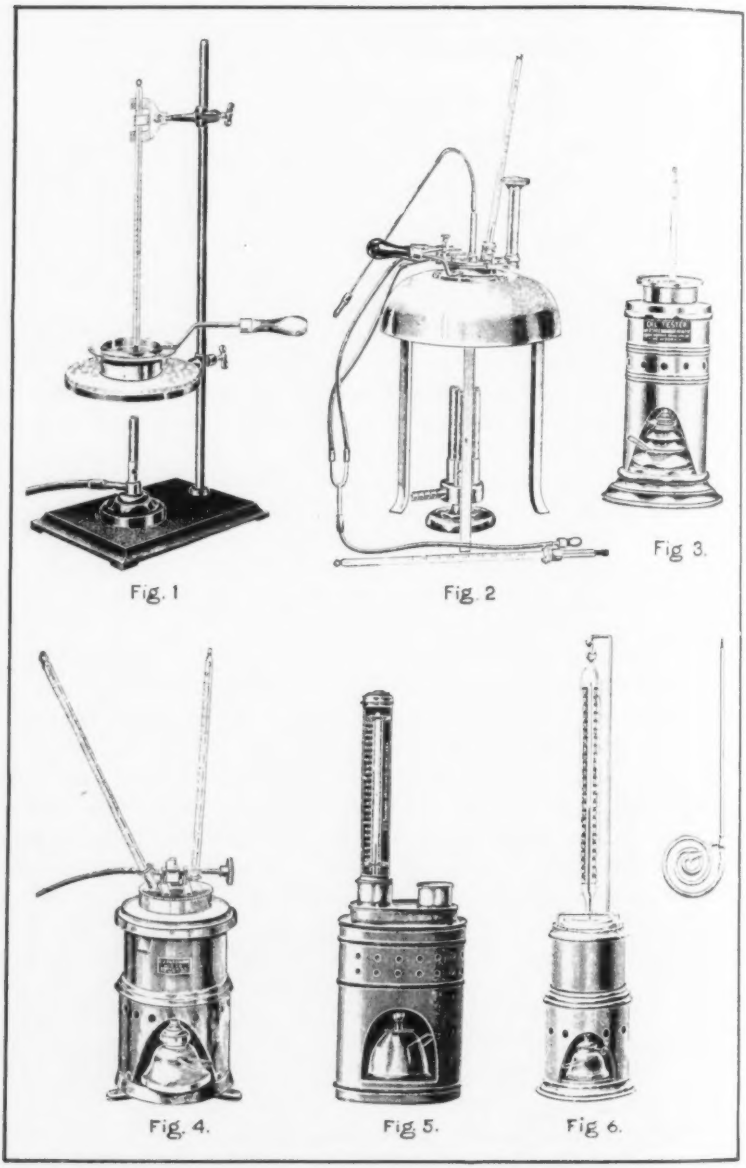

Fig. 1

Fig. 2

Fig 3.

Fig. 4.

Fig. 5.

Fig 6.

Fig. 1. Cleveland Open Tester.
Fig. 2. Pensky-Martens Closed Tester.
Fig. 3. Elliott Closed Tester.
Fig. 4. Tag Closed Tester.
Fig. 5. Foster Closed Tester.
Fig. 6. Tag Open Tester.

The Cleveland Open Cup has been standardized for open cup determinations. It consists of a copper cup 1/8" thick 2½" in diameter 1 5/16" deep to which is attached a guard ring near the top. The cup is filled with the commodity under test up to the filling line which is marked clearly on the inside of the cup 3/8" from the edge. This is then placed upon a tripod the metal plate of which is covered with a ring of asbestos board so as to prevent radiant heat from reaching the sides of the cup. The temperature is measured by a thermometer suspended in a vertical position so that the bottom of the bulb is 1/4" from the bottom of the cup. Heat is applied to the bottom of the cup in such a manner that there will be no danger of local super-heating. The rise in temperature should be 10°F. plus or minus 1°F. per minute. At every 5° rise, the test flame which should be 5/32" in diameter is drawn in a straight line across the diameter of the cup in a plane with the upper edge. The flashpoint is the temperature read on the thermometer when a flash appears at any point on the surface of the varnish. This should not be confused with the bluish halo that sometimes surrounds the test flame.

The objection raised in regard to this method is that the most volatile and therefore the most inflammable gases escape first but not in sufficient quantity as to be readily ignited and hence the flashpoint is higher than the true value. Nevertheless this is exactly the condition that exists when a paint or varnish is kept in an open container such as occurs in a shop using it for dipping purposes.

The Closed Cup is recommended by the American Society for Testing Materials for all determinations where volatile flammable liquids are involved. The procedure is completely outlined in their Standards under Serial Designation 56-21.

The Closed Cup apparatus consists of a metal cup similar to the open cup surrounded by a water bath and the whole encased in a metal shield equipped with a tight cover so that there will be no escape of the volatile vapors. A stirring rod is provided so that the temperature of the varnish may be kept uniform throughout. The test flame burner is mounted on the cover so that it may be automatically introduced into the cup upon opening of a slot. The size of the flame is regulated by comparison with a bead 5/32" in diameter mounted nearby. Heat is applied by means of an alcohol lamp in the base of the tester and should be so regulated that the temperature rise shall be 1.8°F. per minute. Standard thermometers are provided to give the temperature of the varnish and of the water bath.

As in the case with the Open Cup, the operator should watch carefully for a true flash or slight explosion of the gas and should not confuse this with the halo that surrounds the test flame when the varnish is nearing its flashpoint. Several check tests should be made using in each case a fresh sample until two or more determinations agree within 1°F.

A correction may be made for atmospheric pressure when accurate results are desired. For each rise of 1″ in the barometer reading above the normal 1.6°F. should be subtracted and for each decrease of 1″ in the barometer reading below the normal 1.6°F. should be added.

While this method is undoubtedly more scientific it may be likened to what may be expected should a person open a varnish container and insert a lighted match to see how full it is. While in this day we do not expect anyone to be so foolish this is exactly the condition that exists when the attempt is made to bake a varnish in an oven having little or no ventilation. A fire is sure to occur if the oven is heated by direct gas or in the case of electric heat if there is a defect in the wiring.

Occasionally it is found that the desire for a material having a high flashpoint is based upon the idea that such a material will reduce or eliminate the fire hazard under production conditions where the varnish is heated to temperatures considerably above those encountered in the normal room. This is an erroneous impression particularly in baking operations. The flashpoint of a varnish or paint is dependent upon the flashpoint of the volatile portion or solvent. These solvents flash at temperatures ranging from below room temperature to a little above 100°F. Most volatile materials flash at low temperatures the less volatile at a little over 100°F. It will thus be seen that since baking temperatures are above 212°F. that the material will be heated to a point far in excess of the flashpoint; hence there will be no difference in the fire risk whether a material with a low flashpoint is used or one with a high.

On the other hand danger of fire can be reduced to a minimum by proper ventilation not only in the ovens themselves but also around the varnish tanks. Necessity for air in given proportions has already been pointed out in the definition for flashpoint. If an excess of air is present there can never be an inflammable mixture with the vapors given off from the varnish. Furthermore it must be remembered that these vapors will not ignite of themselves; a flame or spark is required.

Flashpoint therefore is only one of several features to be considered in estimating a fire hazard. It should not be used as a means of determining the suitability of a varnish or paint for a given piece of work. Its value lies rather in its use as a means of determining the relative inflammability of a substance for storage or shipping purposes.

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Our readers will be interested to know that Wilson-Maeulen Co., Inc., have just broken ground for an addition to their factory. This addition will be 54′x40′, and four stories high, of reinforced concrete construction, exactly like the construction of the present factory. This will permit lateral extension of the Machine Shop, the Assembly Department, the General Offices, and the Development Department, and is occasioned simply by the increased demand for their various instruments. In other words, in their present quarters all departments are crowded.

The Care of Electrical Instruments

*E. S. Lincoln**

IN a properly located and operated standardizing laboratory the facilities are such that the larger primary instruments are usually well protected, and are not subject to much abuse.

It is the portable measuring instrument that is often neglected in its daily use. In Fig. 1 is shown a portable voltmeter that has been in use for thirty-two years and has never been returned to its makers for repairs. This instrument has received proper care. The effort necessary to properly care for instruments is nothing in comparison to the results to be obtained.

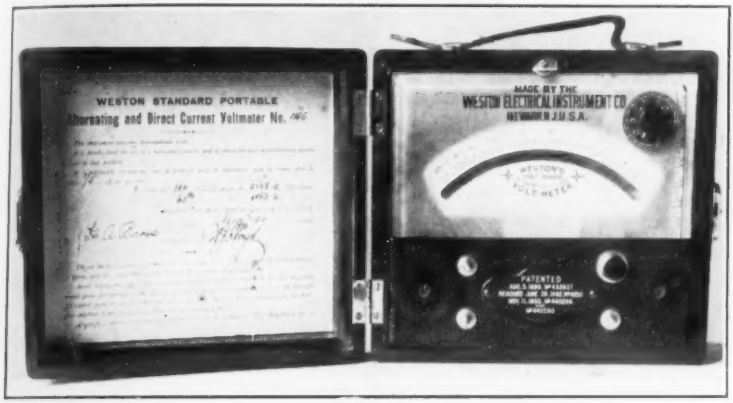

Fig. 1

Listed below are a few suggestions which are well worth while to consider by those who have anything to do with electrical instruments of any nature.

When an instrument is first received a record should be made showing its number, model, and other details. In case of loss at some later date, you can then notify the makers and they will automatically notify you in case it should ever be returned for repairs. Instruments should be listed on the inventory of the company and a careful record made for future use.

When testing equipment consists of many instruments it is a good policy to distinguish each by a special number instead of using the manufacturer's number upon the instrument. This suggestion may be adopted by a small key tag fastened to the instrument or by means of a small nameplate fastened to each instrument case. Some owners paint the details of the instrument on the outside case. These numbers can be used for reference and quick identification. Fig. 2 suggests a method of identification by using a common key tag. Never use nails to attach such tags or pound screws to start them.

*Consulting Electrical Engineer, New York, N. Y.

When instruments are kept in cabinets the pigeonhole containing these instruments should be marked with the same number as the instrument, making it easy to locate quickly any particular instrument. Switchboard meters can best be marked by means of a small number pasted in some inconspicuous place or on the front of the meter, as shown in Fig. 3. These numbers may be obtained from small calendars or may be purchased in gummed sheets from the Dennison Manufacturing Company of South Framingham, Mass.

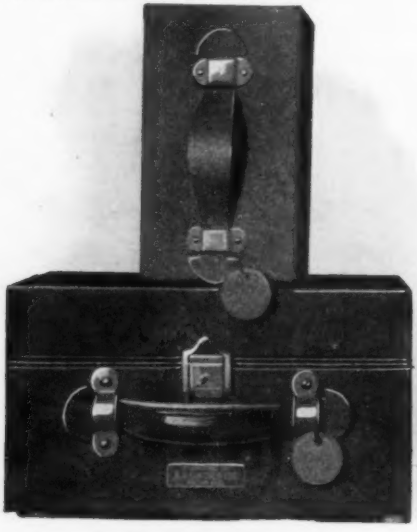

Fig. 2
Use of Key Tag for Instrument Identification

Fig. 3. Number Applied to Switchboard Instrument

Numbers and tags should be covered with a transparent varnish or white shellac for protection. Where a large number of transformers are to be marked, these small tags, properly marked, may be purchased at a low cost. Such a system of numbering instruments, meters, and transformers will be found of great convenience in making tests, as manufacturers' numbers are usually high and often difficult to read.

A form of card to use in indexing instruments, as shown in Fig. 4, is

(Name of Company)

Meter..... Current..... Shop No.....

Make..... Maker's No.....

Inventory No..... Amps..... Volts.....

Value each scale division..... Phase.....

Date Purchased..... 192..... From whom.....

Scales..... Leads..... Condition.....

Accuracy..... Weight..... Case.....

Model..... Potential Key.....

Reversing switch..... Multiplier.....

Shunts.....

(Checking record on back.)

CHECKING RECORD

Date..... 192.....			Date..... 192.....		
Std.	Meter No.	Correction	Std.	Meter No.	Correction

(Details of meter on other side.)

Fig. 4. Checking Card for Use With Instruments

recommended. On the back of this card may be recorded the checking record of the instrument.

When instruments are not in use they should be put away in some location that is free from dust, oil, heat, moisture and excessive vibrations. A bookcase or some covered partitions offer good storage space for instruments of any nature. When not in use all instrument cases should be closed, and instruments provided with separate cases should be kept in their containers.

In making tests it is absolutely necessary that a proper place be selected for the different instruments, and they should not be placed upon the floor as they are liable to become injured and in that position they are extremely hard to read. When using instruments intermittently over any extended period of time, without disconnecting them, it is recommended that they be properly covered with canvas or some water-proof covering.

When instruments are being carried for any distance leather carrying cases made to fit are recommended.

The packing of instruments for transportation should be given careful consideration, and whenever they are shipped for any great distance they should be packed in excelsior after being carefully wrapped in paper. Excelsior absorbs the vibration better than any other packing material.

When instruments are carried on trains, trolley cars, or in automobiles, it is not good practice to allow them to rest on the floor or on the seat unless it is provided with a cushion.

Excessive vibration is liable to damage any instrument in time. If no cushions are available it is better to carry them in the lap unless packed in a box containing excelsior. Always lift the instruments and never allow them to slide on their rubber supports.

Instrument transformers having no movable parts can stand more vibration and do not require as much care as pivoted coil instruments.

The covers on the large size Portable Precision Instruments can usually be removed. This is very convenient when a number of instruments are used in making some particular test. Be sure that these covers have proper protection when not in use, and that they are put back on the proper instrument when the test is completed.

Polishing wooden meter cases occasionally with some good furniture polish will assist in keeping them in first-class condition. The better the appearance of an instrument, the more care is applied in handling and using it.

If a meter becomes damaged or needs attention in any way, ship it direct to the manufacturer with transportation charges prepaid. Protect the glass over the scale to avoid breakage, place your name and address inside the instrument case, and also write a letter to the maker, giving the number and model of the instrument, how shipped, and the work you wish done. Be sure to keep a copy of your letter and the number and model of your meter.

Integration of Diagrams

For which the Movement of the Pen is Proportional to the "Orifice Head" by Means of Ordinary "Area-Measuring" or "Radial" Planimeters

John L. Hodgson, M. Inst. Mech. E.

THE pen movements can be recorded on two types of chart; the cylindrical type as illustrated in Figs. 1a and 1b, and the disc type as illustrated in Figs. 2, 3a and 3b.

"The "area-measuring" planimeter is adapted to find the mean height of diagrams drawn on cylindrical charts, and the "radial" planimeter the mean height of diagrams drawn on disc charts.

Provided that this mean height corresponds to the mean head, the mean flow can be calculated.

In what follows it is assumed that the pen motion is proportional to the "orifice-head" and that the flow to be measured is proportional to the square root of the "orifice-head" recorded.

It is shown in Appendix I that if the "mean height" be obtained for an "orifice-head" diagram drawn on a cylindrical chart by integrating the diagrams with an ordinary "area-measuring" planimeter, the square root of the "mean head" corresponding to this "mean height" will not differ from the square root of the true "mean head" by more than 1.5 per cent provided that it is possible to include the whole of the pen travel between two lines which are drawn at distances A and B from the time base OX, see Fig. 1a; and for which the distance OA is not less than half OB.

Furthermore that if OA is 0.6 times OB, the error in the planimetered flow cannot exceed 0.7%, and if OA is 0.7 times OB the error cannot exceed 0.4%.

The usual errors will be about half these amounts, so that if allowance is made according to the following table practically no error at all is introduced.

Table I

Ratio $\frac{OA}{OB}$	Possible Maximum (+) Error %	Proposed Deduction %
0.5	1.5	0.75
0.6	0.7	0.35
0.7	0.4	0.20

It will be obvious that if small peaks or depressions such as D in Fig. 1a lie outside the boundary lines above described, these will not cause appreciable errors if they represent only a small proportion of the

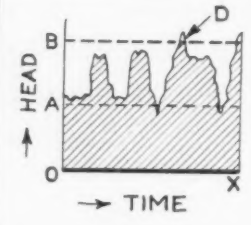

Fig. 1a

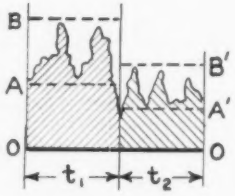

Fig. 1b

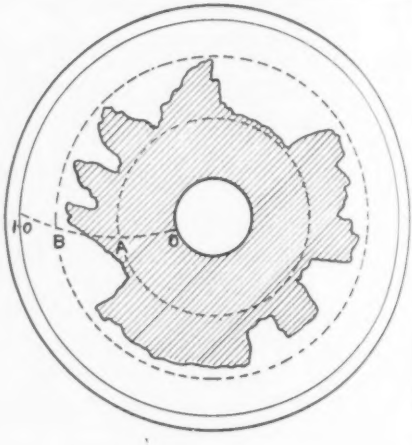

Fig. 2

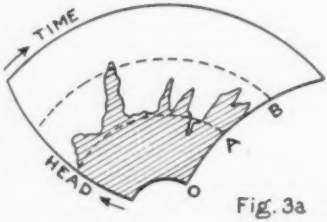

Fig. 3a

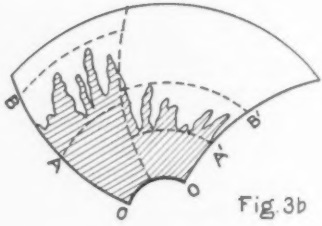

Fig. 3b

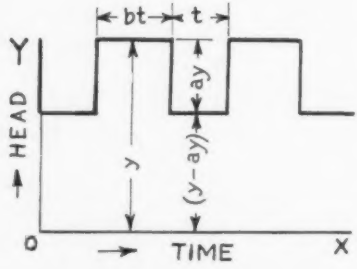

Fig. 4

Figs. 1a and 1b. If OB/OA or OB'/OA' is less than 2 for a particular area, the flow is proportional to the square root of the mean reading obtained for this area by means of an ordinary "area measuring" planimeter.

Figs. 3a and 3b. If OB/OA or OB'/OA' is less than 2 for a particular area, the flow is proportional to the square root of the mean reading obtained for this area by means of an ordinary "radial" planimeter.

total quantity registered by the chart; also that less error is made by including such peaks and depressions in the planimeter traverse than by leaving them out.

This simple rule enables charts, such as are shown in Fig. 1a to be integrated without further trouble, and its application leaves no doubt as to whether or not a particular diagram can be integrated by means of an "area-measuring" planimeter without dividing it up into sections as shown in Fig. 1b.

In case it is impossible to choose boundary lines for which the ordinate OB is twice the ordinate OA as in Fig. 1a, which include the whole, or practically the whole, of the pen line, the chart may be integrated in sections as shown in Fig. 1b; the average head for each time t_1, t_2, etc., being determined and used for obtaining the total flow.

The above rule enables *any "orifice-head"* diagram drawn on a cylindrical chart to be integrated by means of an ordinary "area-measuring" planimeter. It will, however, be obvious that in those cases where the diagram would have to be integrated in many sections it is preferable to use a special "square-rooting" planimeter, from which the mean height can be obtained directly irrespective of the fact that the pen line does not lie between the boundary lines which lie at given distances from the time base. The same general rule applies to circular charts, such as are shown in Figs. 2, 3a, and 3b. In this case, however, the mean height of the chart must be found by means of a "radial" planimeter.

The rule for integrating "orifice-head" diagrams may be summarized for both the cylindical and the radial type of chart as follows:

For portions of the diagrams, such as those shown in 1a and 1b, which lie between lines whose distance apart is AB (or A′B′) and for which OA (or OA′) is not more than half OB (or OB′):—

(a) Go round the area by means of an "area-measuring" or a "radial" planimeter, as the case may be.

(b) Divide the planimeter reading so obtained by the time interval corresponding to the area considered in order to obtain the mean height of this area.

(c) Take the square root of this mean height in order to obtain a number which is proportional to the mean flow.

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APPENDIX I

Proof of the rule given in the preceding notes for integrating cylindrical "orifice head" charts by means of an "area-measuring" planimeter

If we assume that the "orifice-head" pen has drawn a series of rectangular peaks as shown in Fig. 4, and that the flow at any instant

$$= K\sqrt{y} \qquad (1)$$

K = a constant
y = the instantaneous value of the "head"
t = time interval corresponding to the duration of the trough of the wave form,

and a and b are multipliers of y and t respectively.

Then
The Average "Head" $= \dfrac{(y - ay)\,t + ybt}{(t + bt)}$ ..... (2)

and
The Average Flow as calculated from the average head by (1) $= K \sqrt{\dfrac{(y - ay)\,t + ybt}{(t + bt)}}$ ..... (3)

while
The True Average Flow $= \dfrac{Kt\sqrt{(y - ay)} + Kbt\sqrt{y}}{(t + bt)}$ ..... (4)

Hence
$$\frac{\text{The Average Flow as calculated from the average head}}{\text{The true average Flow}} = \frac{(3)}{(4)} = R = \frac{\sqrt{[(1-a) + b]\ [1\ b]}}{\sqrt{(1-a)} + b} \quad \text{..... (5)}$$

If now we vary a and b we can calculate by means of Equation (5) a series of values of R such as those tabulated below.

Table II

b	Values of a		
	0.5	0.7	0.3
2.0	1.010	1.006	1.0025
1.0	1.015	1.007	1.007
0.5	1.012	1.007	1.003
0.2	1.010	1.005	1.003

From such a table it will be seen that the greatest errors occur when $b = 1$, and that even when $b = 1$ and $a = 0.5$, the error in the estimation of the flow cannot exceed 1.5% fast.

A simple extension of the above proof makes the rule applicable to the "orifice-head" diagrams drawn on disc charts, provided that these are integrated by means of a "radial" planimeter.

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It is common experience that next to possessing information the ideal consideration is to know where to find it. This is especially true at present when the vast amount of information probably available on almost any subject is so great as to lie beyond the capacity of an individual. The problem usually is to know where to find what is wanted.

The world-wide demand for information of all kinds has grown so rapidly that one is often at his wit's end to know where to look for it.

If you are looking for instrument information—you will find it in Instruments.

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Instruments Book Shelf

IN this section the recent books on instruments, measuring devices, tests, inspection and control, etc., will be reviewed.

Orders for copies of the books reviewed there, can be sent to INSTRUMENTS BOOK SHELF, c/o INSTRUMENTS PUBLISHING COMPANY, 1117 Wolfendale Street, Pittsburgh, Pa.

New Instruments

Recently Developed by Instrument Manufacturers

Carl Zeiss Precision Measuring Machine

(George Scherr Co.)

THE Precision Measuring Machine is distinctly a master gage of the first order, as it permits obtaining absolute measurements within the closest limits directly; that is to say without the aid of comparative standards. It is indispensable for a variety of work which due to its size, shape or infrequency can either not be conveniently measured otherwise, or for which dependable comparative standards are not available or difficult to provide. Being intended for absolute measurements, the first requirement of a Precision Measuring Machine is that it should be so built as to present by its arrangement an unvarying standard of measurement. This ideal has been approached to a remarkable degree in the Carl Zeiss Optical Measuring Machine illustrated in Fig. 1.

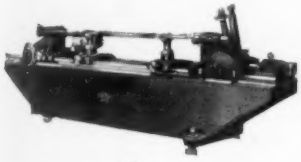

Fig. 1

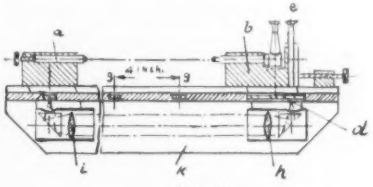

Fig. 2

Its construction has been based on an entirely new optical principle, whereby micrometer screws as well as devices for controlling their rather excessive measuring pressure have been eliminated entirely. In their stead only glass scales are being used together with an optical indicator (OPTIMETER). These glass scales, being permanently fixed and being only observed through the microscope, will not wear and therefore retain their original accuracy indefinitely.

The principle of design is best explained by reference to the diagram in Fig. 2.

As can be seen the machine consists principally of bed "k," headstock "b" and tailstock "a." Imbedded in a soft steel rule and located in the bed are glass marks "g," 4 inch. apart from each other, as well as glass scale "d" which is 4 inch. long and subdivided into inches, tenths and hundreds by .005". Attached to both the headstock and the tailstock are

units of an optical (collimating) system "h" and "i" respectively. Through this system the lines of the glass marks "g" in the bed for a given position of the tailstock are transferred by means of proper illumination into the microscope "e," where they are observed simultaneously with the image of the glass scale "d." In other words, no matter in what position the tailstock may be, all readings are always obtained in this one microscope, except for the subdivisions of .005". These are furnished by an adjacent Optimeter tube in .00005", the scale having a range of plus and minus .005" and an inherent accuracy of .00001" (described in INSTRUMENTS" for May, 1928).

The characteristic advantage of the collimating system is its self-compensating feature for errors caused by slight irregularities or wear of the ways for headstock and tailstock and their resultant lack of parallelism respectively.

The glass scales are made of carefully aged glass with the same co-efficient of expansion as the steel in which they are mounted. The graduation is produced by a special interferometric process and calibrated for the correct position of the lines within .000008". Allowing for the usual errors in setting and reading, the average working accuracy of the machine will be:

$$\text{for lengths up to } 4'' \qquad .00002 + \frac{\text{length in inch.}}{200000}$$

$$\text{for lengths over } 4'' \qquad .00002 + \frac{\text{length in inch.}}{100000}$$

As an example, this would correspond to an error of .00003" for 2" of length and .00007" for 5" of length.

To operate the machine the tailstock by means of a handwheel is moved to the zero mark in the bed. Next the headstock is set to zero over the glass scale "d," whereby both measuring anvils contact, a constant but very light pressure of about 7 ounces being maintained by the Optimeter tube. A fine adjustment permits to set the Optimeter scale to zero, whereupon the setting is completed and the machine ready for taking measurements.

For the handling of long cylindrical work such as spherical endrods, a pair of roller V-supports is provided. Flat work is placed on a square table which floats on balls in longitudinal direction and has cross adjustment as well as vertical travel by means of rack and pinion. The equipment also includes an auxiliary attachment for inside measurements, thus making the machine fully universal in its scope.

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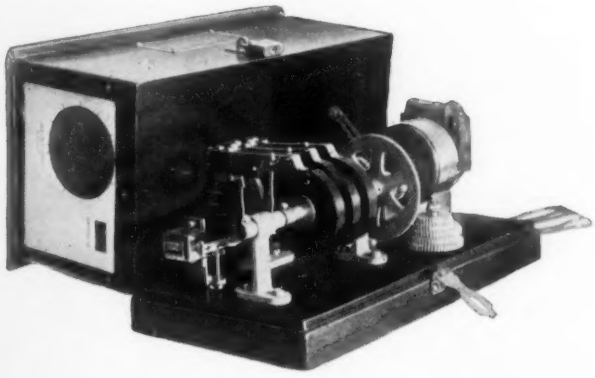
Every purchaser pays the cost of selling him the goods he buys. It is the seller's business to use every means to keep the selling cost low and make the service worth all that it costs.

Time Cycle Contactor

(Automatic Temperature Control Company, Inc.)

TUNNEL type furnaces where hydraulic and pneumatic cylinders are used for operating doors advancing furnace load and moving conveyor for placing charge of work in front of the ram for the next cycle can be operated automatically on a definite time program by means of four-way motor operated valves for each cylinder actuated by a time cycle contactor of the programme type.

The figure shows such a time cycle contactor which can be furnished in the "Cycle Repeat" type or in the "Cycle Stop" type as required. As the name implies, the "Cycle Repeat" type contactor will continuously repeat its cycle while the main switch is closed whereas the "Cycle Stop" type is actuated by a manually operated push button switch, runs its cycle and stops until the switch is again manually closed. For the application here described, the time cycle unit is equipped with seven contact discs. The timing drum can be geared for any desired time cycle and change gears provided permit altering this cycle to meet change in work under treatment.



Within time of the cycle the contact discs are individually adjustable is relation to each other, but where work under treatment is frequently changed and requires new setting of the individual contact discs, spare drums can be provided complete with contact discs spaced to order. These drums can easily be interchanged, and under certain conditions their use will prove a saving in time.

The motor operated valve equipment is positive in action, well constructed and built for service.

Where tunnel or continuous type furnaces have motor operated door and load advancing mechanism, suitable relays can be provided to function such motors in desired sequence by one of these time cycle contact units.

Time cycle contactors built for this service normally require but a few minutes per drum cycle, however, these programme type contactors have been built to meet conditions calling for one revolution of drum shaft in ninety-six (96) hours.

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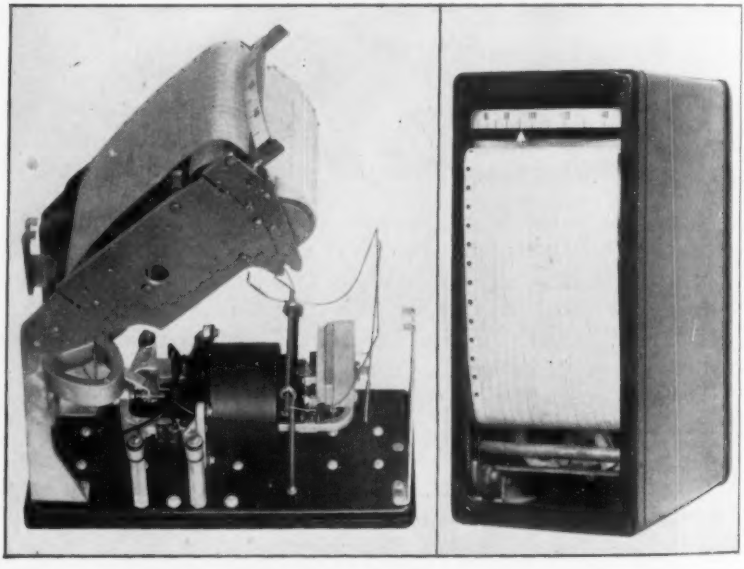
Strip Chart Recording Instruments of New Design

(General Electric Company)

A NEW group of strip-chart recording instruments, known as Type CD, has recently been placed on the market. The instruments are manufactured in mountable and portable form, and include all of the instruments applicable in central station practice. The principal points of difference between the new instruments and the older line are the lower price and the more compact, small overall size.

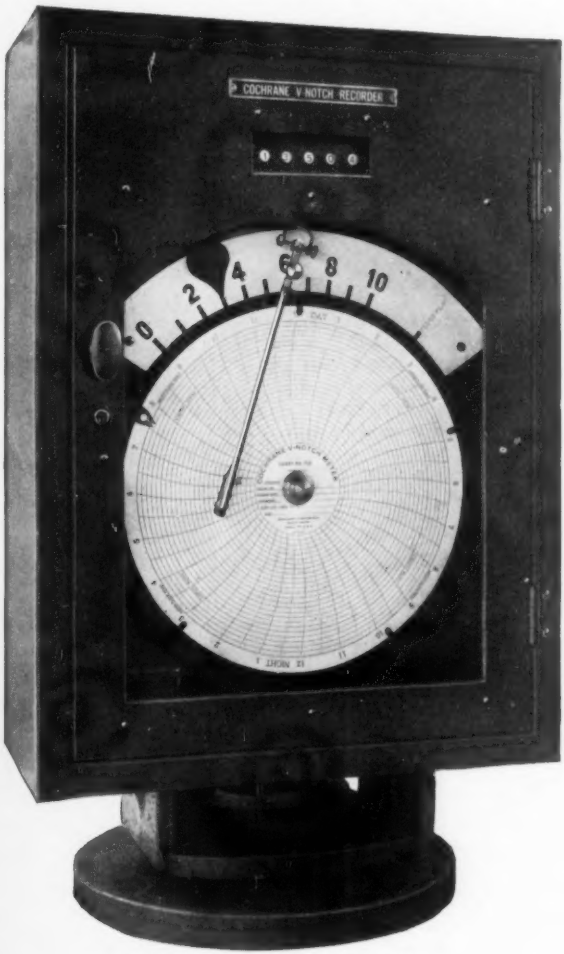
The Type CD instruments are contained in metal cases 12 inches high and only 5½ inches wide, so that four can be mounted side by side on a standard 24-inch switchboard panel. A quick detachable cover with glass window is provided, a feature which makes chart renewal simple. The pen-and-inkwell arrangement is also of improved design, giving greater accessibility than in older types. Other improvements include a hinged chart frame which can be lowered to expose the entire chart mechanism, and a more efficient system of magnetic damping. The chart mechanism is driven either by an 8-day clock or by a small synchronous motor.



An Improved V-Notch Weir Recorder

(Cochrane Corporation)

IF the flow over a weir increased proportionately to the head, the recording pen, pointer and integrator devices could be attached directly to the float rod, giving the simplest possible kind of recorder. In fact, weirs having this property of flow proportional to head have been devised, but they are not satisfactory as weirs. The V-notch weir is unquestionably the best as regards flow properties,

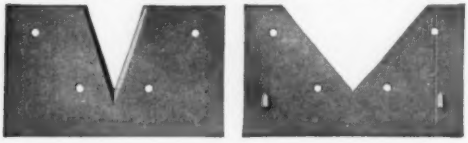


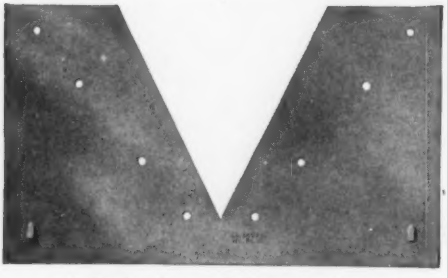
Cochrane Type E, V-Notch Recorder

particularly where there are wide variations in the rate of flow, since it is accurate at small fractional flows as well as at full flow. Its properties have been exhaustively investigated and it is easily and inexpensively reproduced to correct and standard dimensions.

In order to record the flow over a V-notch on a chart having uniform graduations, however, it is necessary to use some form of rectifying mechanism.

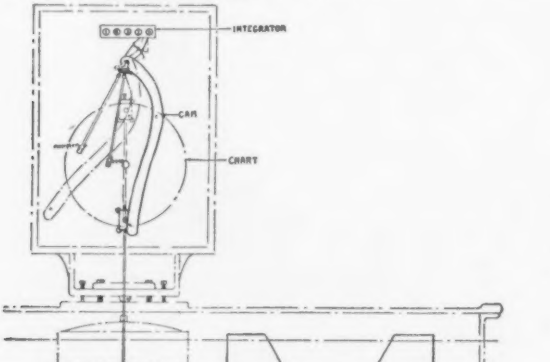
At first thought it might seem a simple matter to attach a cam directly to the float stem so that it would push the pen sidewise the correct distance as the float rose. Due to the fact, however, that the flow over a V-notch increases as the 5/2





Cochrane V-Notch Weirs. The two halves of a weir are machined as separate parts and then brazed together while held in a jig. The edge or lip is absolutely straight and uniform. The gauge points for leveling and for adjusting the water level to zero are located at the same time. Where corrosive liquids are to be metered, notch plates of suitable materials are supplied.

power of the head, it will be seen that such a cam would become very steep at the high flow end and there would be a tendency for it to bind. In former recorders this difficulty was overcome by various expedients, as by winding the cam in a long helix around a cylinder and multiplying the motion by means of a rack and pinion, or by laying the cam out in a spiral on a large disk and multiplying the motion by means of a cable and drum.



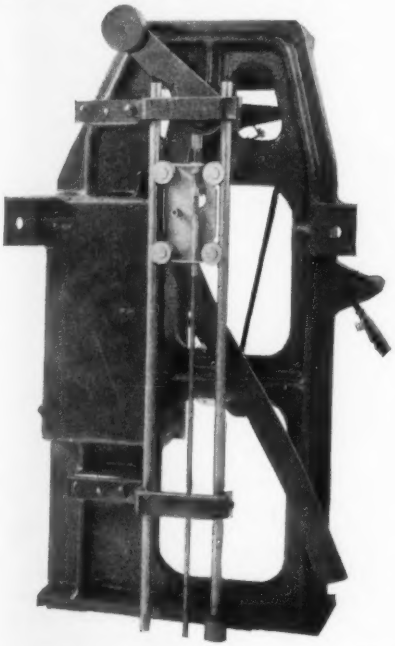
By means of an outside zero pointer level with the apex of the notch, it is possible to adjust the V-notch recorder to zero at any time, even when the apparatus is filled with hot water and steam.

In the new Cochrane V-notch Recorder, shown herewith, a remarkably simple and effective solution has been found. The *cam* is hung from pivot bearings and oscillates in a vertical plane, while a roller carried by the float stem and moving up and down in a straight line bears against the edge of the cam, approaching the axis or center of oscillation of the latter at the higher flows. With this dispo-

sition of the parts, it is easy to get the required transformation of motion with a cam of comparatively simple form, for as the roller approaches the center of oscillation its effect in moving the cam angularly is increased, just what is required to accommodate the 5/2 power law. A slight biasing weight on the cam keeps the latter always in contact with the roller.

The *pen arm* is attached directly to the cam spindle; while the *visible pointer* is mounted on a separate spindle connected to the cam by a link motion. The operation of the *integrator* is controlled by motion received through a pair of toothed sectors. The positive, direct drive from the float to the recorder pen eliminates the slack or back-lash found in rack and pinion or cable transmissions and rapid up and down movements of the float cannot put the instrument out of order.

The integrator is of the clock-driven type and imposes no restraint upon the flow measuring parts. The gear train consists of spur gears, each pair having a ratio of 10 to 1. There is only one tooth on the pinion and ten teeth on the



Recorder mechanism from rear, with float rod in place.

gear. This one tooth engages for only a part of a revolution, the gear being held stationary during the remainder of the pinion revolution, as the remainder of the pinion has no teeth, but is circular and bears between two adjacent teeth of the gear. The result is that two adjacent teeth of the gear, except the first or highest-speed gear, advances always a whole number at a time. Except for the first dial, there is, in other words, no gradual, continuous movement of the figures, as would be the case were an ordinary gear train used.

Now, the first, or highest-speed, gear is advanced by varying small increments which are proportional to the momentary rate of flow. To secure this result, a rod attached to a crank rotated by the clock operates a clutch which engages with the milled edge of a disk mounted on the spindle of the first counter train pinion. Each stroke of the clock pulls the clutch back to the starting point, where it engages with the milled disk, and then pushes it forward until the clutch is thrown out of engagement by a cam. The position of this cam is determined by the position of the main cam, and therefore by the rate of flow, the transmission of motion from one cam to the other being made by a pair of toothed sectors. It

will be seen that the counting train is thus advanced for each interval of time by an amount proportional to the instantaneous rate of flow and that the result for a longer period of time is totalized or integrated flow.

Only one clock is required and this may be either of a powerful double-spring type or an electric clock may be used where alternating current of controlled frequency is available.

Discharge Coefficients for V-notch Weirs: The triangular or V-notch weir has the advantage that the head to be measured at small flows is relatively large and that the cross-section of discharge for any given angle at the apex is similar at all heads. For the theoretical equation $q = ch^{5/2}$. James Thompson, who experimented upon V-notch weirs at Belfast in 1858, chose a mean value of c of .305 for a right-angle notch, q being measured in cu. ft. per minute, and h in inches. James Barr, who made several hundred experiments, gave the following values for the discharge through a 90° narrow-edge, smooth brass notch with a practically unlimited approach channel:

BARR'S RESULTS FOR THE FLOW OF WATER THROUGH A 90° V-NOTCH WITH UNLIMITED APPROACH

Head in Inches	Value of Coefficient C	Flow in Cubic Feet per Minute	Flow in Gallons (Imperial)
2	0.3104	1.755	10.94
2½	0.3084	3.045	18.97
3	0.3068	4.782	29.79
3½	0.3057	7.002	43.63
4	0.3047	9.750	60.74
4½	0.3038	13.05	81.29
5	0.3032	16.95	105.6
5½	0.3026	21.46	133.7
6	0.3021	26.63	166.0
6½	0.3017	32.49	202.4
7	0.3013	39.05	243.0
7½	0.3009	46.34	288.7
8	0.3006	54.06	338.9
8½	0.3003	62.92	392.0
9	0.3000	72.90	454.2
9½	0.2998	83.33	519.2
10	0.2995	94.70	590.0

The above results, which Barr believes to give the true discharge within 1/3 of 1 per cent, are well represented by the formula $q = .31358\ H^{2.48}$.

Tests on a notch cut in a steel plate beveled to 1/8 inch, made under the direction of H. W. King, gave the following:

These values are about 2 per cent higher than Barr's, which King explains as being due to the roughness of the steel notch plate. They can be represented quite accurately by the formula $q = 2.52\ H^{2.47}$ in which Q is in cubic feet per second and H in feet.

The flume was 8.05 feet wide and about 5 feet deep, and the apex of the weir was 2.0 feet above the bottom of the tank. The head was measured with a hook gauge in a pail attached by a hose to the side of the flume about 6 feet upstream from the weir. The discharge was weighed.

Doebler and Rayfield who made tests on a 28° 4-foot notch with heads up to 3 feet, report the formula $Q = 0.6405\ H^{2.445}$.

V. M. Cone, who experimented on a 120° notch with heads up to 1.35 foot, obtained $Q = 4.40\ H^{2.487}$, while with a 60° notch he obtained $Q = 1.446\ H^{2.470}$.

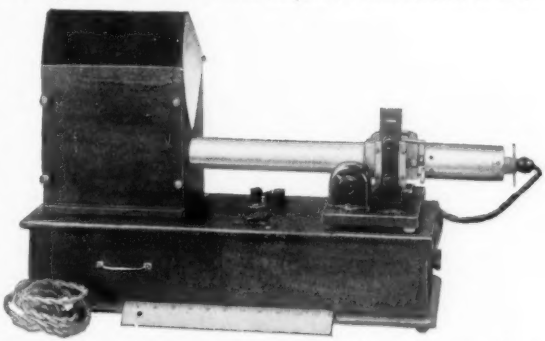
To obtain the coefficient for a notch of a different angle, modify the coefficient which has been determined by experiment for a notch of nearly the same angle in the ratio of the tangents of the halves of the respective angles.

In order that the flow may be independent of the channel width, the latter, as shown by Barr, should be at least eight times the head on a 90° notch, while the depth of the channel below the apex should be about three times the head with a 3-inch head, and four times the head with a 4-inch head.

Type 338 String Oscillograph

IN many lines of work and experimentation with alternating currents the need is frequently felt for a simple, sensitive, portable, and inexpensive oscillograph, with which one may view with ease either sustained wave forms or transient currents and voltages existing at any point in an electrical circuit or network. To meet this requirement the General Radio Company has designed a compact and moderately priced instrument which may be used for the following two distinct purposes:

1. As a string oscillograph which operates with much less power than is usually required by such instruments, but which affords a satisfactory means for the visual examination of wave forms over a wide range of frequencies. The wave of either current or voltage is traced by the shadow image of a very fine vibrating wire rather than by a spot of light reflected from a mirror attached to a moving system. The vibrating element can, accordingly, be made much lighter, resulting in an increased sensitivity of the instrument. The uses for such an instrument are manifold, as, for example, the observation of large or small alternating currents in the laboratory, power house, or class room; the visual examination of telephonic currents in simple or complicated circuits; and when combined with some form of microphone or magnetophone, the study of mechanical vibration occurring in moving machinery or in bridges or other structures subject to intermittent stresses. For many such lines of work the portable nature of the equipment is of especial value.



2. As a reliable vibration galvanometer, the string of which may be tuned to give a good degree of sensitivity at any desired frequency over a considerable range. In this respect the instrument is especially useful as a null-point detector in AC. bridge measurements when using low frequencies at which the telephone receiver becomes insensitive and otherwise unsatisfactory. As the galvanometer has no coil in the magnetic field, its reactance is practically nil when the string is not vibrating, a feature which is desirable for certain applications.

An idea of the sensitivity of the instrument may be obtained from the following data. Using a string of 0.0004-inch tungsten wire, undamped, and tuned to the fundamental of the applied AC. frequency, the following potentials are required to produce a wave form having an amplitude of one millimeter:

At 60 Cycles	0.2 Millivolt
At 250 Cycles	1.0 Millivolt
At 500 Cycles	2.4 Millivolts
At 1000 Cycles	8.5 Millivolts

The DC. sensitivity of the same string when tuned at various frequencies is seen from the following data, which gives the DC. potentials required to give a deflection of one millimeter on the screen:

At 60 Cycles	0.0047 Volt
At 250 Cycles	0.065 Volt
At 500 Cycles	0.30 Volt
At 1000 Cycles	1.31 Volts

The resistance of the instrument strung with the 0.0047-inch tungsten wire is of the order of 65 ohms.

The appearance of the instrument may be seen from the photograph. A walnut base cabinet serves to support and to align the several elements. In the left portion of this is a drawer for holding spare string mounting and other equipment.

The galvanometer is mounted upon the right-hand end of the cabinet. It is sensitized by two permanent magnets, thus eliminating the need of a source of direct current for producing the necessary magnetic field. Two specially shaped pole pieces afford a long, narrow, vertical gap in which the string vibrates, and at the same time serve to support the optical system, which consists of a large and a small condenser lens, together with a microscope objective. The large lens and the standard automobile headlight bulb used are located in the lamp chamber seen on the extreme right, while the two small lenses are located within a tube passing through the pole pieces. All three lenses are adjustable along the optical axis, while the lamp is adjustable in three dimensions. This makes it easy to focus the system to give a uniform field of illumination. A thumbscrew, located on the left end of the lamp chamber, slides the optical system as a whole with reference to the string and thereby focuses the shadow image of the same upon the observing screen.

The string is mounted upon a metal rocker arm, which, in turn, is attached to the rear of a vertical bakelite strip as shown in the photograph. Two adjustment screws will be seen protruding through the front of this strip. One of these varies the tension on the string, while the other serves to move the string across the light beam in order to center the image on the screen. Provision is made for damping the vibration of the string, if desired, by means of two drops of oil. The whole string assembly is readily removed, electrical contact being made through two springs on the galvonometer base. Two string mountings are provided with the equipment, each strung with a fine tungsten wire of about .0004-in. diameter. These strings, which are 4½ inches in length, may be overloaded considerably without damage. As they carry no mirror, if they are accidently broken their replacement is a comparative simple operation.

On the left of the galvanometer base is mounted an enclosed potentiometer for adjusting the potential applied to the string, and hence controlling the amptitude of vibration.

On the left of the cabinet is mounted the mirror box, which is likewise made of walnut. It contains a rotating octagonal metallic mirror which affords the necessary time element of linear motion perpendicular to the vibration. The mirror is mounted on the shaft of a small induction motor and is provided with jewelled bearings. This motor is of simple construction, consisting of a circular disc, the periphery of which passes through a gap in a rectangular, laminated core. The core is energized by a high-impedance coil carrying a 60-cycle current, and around one-half of the cross section of each pole are two copper rings acting as "shading coils." The unsymmetrical distortion of the resulting field affords the driving torque. This motor is not inherently synchronous, as its speed may be controlled over a wide range merely by varying the voltage impressed on the energizing coil. This is done by means of a potentiometer, the knob of which seen in the center of the cabinet. A very constant speed of any desired value may be maintained in this manner, making it easy to synchronize the motor to any frequency impressed on the string, producing thereby a stationary wave pattern. For observing transient phenomena of some duration, it is desirable to have the mirror run quite slowly, whereas the maximum speed of the motor is necessary to separate the individual wave forms at the higher frequencies. The 60-cycle wave length at maximum speed is from 2½ to 3 inches, giving a wavelength of about 1/16 inch at 3000 cycles.

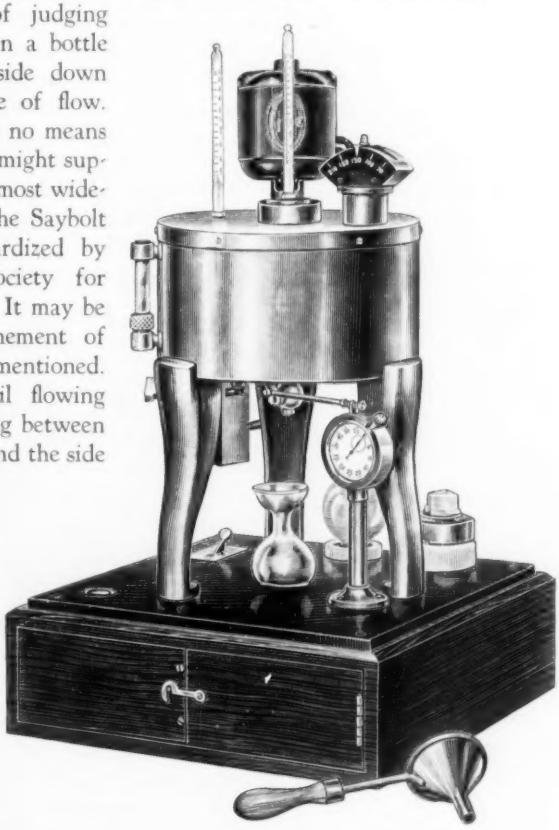
A screen bent on the arc of a circle is seen by looking down into the box, which is provided with an adjustable metallic cover that serves as a hood for shielding the screen when desired. The observer may stand at some distance from the screen and still watch the wave form while manipulating other apparatus. This is a convenient feature. A cylindrical lens is mounted in the mirror box for concentrating the light beam into a narrow line. This sharpens and intensifies the image considerably. The front vertical wall of the mirror box is easily removable for inspection and adjustment of the enclosed parts.

One Motion Control Viscosimeter

(Teschner-Myers Co., Inc.)

VISCOSITY may be defined as the friction between the molecules of a liquid. It is a property of matter that at best is difficult to measure satisfactorily. The money value of the materials evaluated largely on the basis of viscosity tests is almost beyond comprehension because it includes the world-wide commerce in petroleum oil and its innumerable, indispensable products. It seems safe to affirm that no test of comparable importance, that no test having received similar intensive study, remains in such a state of empiricism as does commercial viscosity testing.

One method of judging viscosity is to turn a bottle of the liquid upside down and note the rate of flow. This method is by no means as obsolete as one might suppose. The method most widely used today is the Saybolt method as standardized by the American Society for Testing Materials. It may be considered a refinement of the bottle method mentioned. Instead of the oil flowing through an opening between the bubble of air and the side of the bottle, the Saybolt instrument provides an orifice of standardized dimensions through which the oil flows. Instead of merely gauging approximately the rate of flow, the time required is noted with a split second stop watch. Instead of leaving to chance the all important question of temperature, there are provided baths, stirrers and thermometers.



The accuracy of the test however depends on the alertness and the co-ordination of eye and hand of the operator as is indicated from the

following excerpts from the instructions for carrying out the test (A.S.T.M. Serial D88-26):

> "Bath shall be vigorously stirred . . . insert cork stopper into the lower end of the air chamber at bottom of oil tube, sufficiently to prevent the escape of air, but not to touch the small outlet tube . . . keep the oil in the oil tube well stirred and also stir well the liquid in the bath. . . . It is extremely important that the temperature of the bath be maintained constant during the entire time consumed in making the test . . . withdraw the oil tube thermometer, quickly remove surplus oil from the overflow cup, place the 60 cc flask in position, snap cork from its position and at the same instant start the stop-watch. Stir the liquid in the bath during the test and carefully maintain it at . . . temperature. Stop the watch when the bottom of the meniscus of the oil reaches the mark on the neck of the receiving flask."

Laboratories of some of the large oil companies where these tests are so extremely important, have developed and installed elaborate devices to reduce errors due to the personal equation in carrying out the above procedure, but the complexity of the devices and their high cost have prevented their extension to oil laboratories generally.

There now comes a conspicuous advance in viscosimeters of the Saybolt type and yet it only does the obvious thing: it extends precision mechanical control to each of the important factors of the test. Strict co-ordination between the flow of oil and the stopwatch is achieved by a straight rod! This instrument is called the Teschner "ONE-MOTION" Control Viscosimeter because one motion starts the flow of oil and the stop-watch simultaneously and one motion stops the flow of oil and the stop-watch simultaneously. Temperature control is almost equally as simple because it has a three-heat coil type electric heater that brings the bath to temperature rapidly, a stirrer that keeps the heat uniform and a rugged thermostat that keeps the temperatures at any point desired up to 210°F.

Other improvements embodied in its construction are a thermometer set on support so that it does not need to be removed just prior to the test, a design of the chamber below the orifice that eliminates the possibility of error through oil flowing through before the test is started; the stop-watch is well protected and is exposed only to the gentle pressure of the "ONE-MOTION" control mechanism; level and leveling screws are provided, a composition base has an inset to protect the flask, and there are also an improved funnel for introducing the oil into the cup and a pilot light. A drawer in the base may be used for accessories. It is complete in every detail.

Catalogue Library

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Accurate Production Records
is the title of a small leaflet issued by the Durant Manufacturing Company, 655 Baffum St., Milwaukee, Wis. Illustrates various applications of their productimeters.

Aerial Navigation Instruments
Henry Hughes & Son, Ltd., London, England, have published a booklet entitled "Instruments for Aerial Navigation."

Brinell Hardness Tester-Portable
Cat. No. 1004 issued by Mohr & Federhoff, Mannheim, Germany, illustrates their tester PZ3. This leaflet is printed in English.

Carbon Dioxide Recorder
Pamphlet No. 62 published by Walker, Crosweller & Co., 54 Queen Elizabeth Street, London, S.E.1., England, illustrates their Akron CO_2 recorder.

Commutator-Fleming
H. Tinsley & Co., South Norwood, London, S.E.-25, England, illustrate the Fleming Commutator in their List No. 41.

Condensers
List No. 19 of H. Tinsley & Co., South Norwood, London, S.E.-25, England, covers their standard and high insulation condensers.

Counters
The various Veeder counters manufactured by the Veeder-Root Co., Hartford, Conn., are shown in their catalog 2500.

Counters—Combined Stroke and Revolution
Sonder-Liste No. 4 of Irion & Vosseler, Schwenninger an Neckar, Germany, illustrate their combined stroke and revolution counters. This catalogue is printed in German.

Counters
R. E. Hart Mfg. Co., 14 St., Battle Creek, Mich., have issued their catalogue A to cover Hart "Standard" Counters.

Curve Tracer
The Curve Tracer or Ondograph, is an instrument for obtaining curves of alternating current wave forms. It is illustrated in List No. 62 of H. Tinsley & Co., South Norwood, London, S.E.-25, England.

Coil Galvanometers
N. V. v. h. P. J. Kipp & Zonen, Delft, Holland, have issued a leaflet giving sensitivity data on their galvanometers. This is printed in English.

Dilatometer
Bulletin No. 2808 issued by Stanley P. Rockwell Co., 66 Trumbull Street, Hartford, Conn., discusses the importance of time control in Heat Treatment where distortion is detrimental.

Dosimeter—X-Ray
The Fricke-Glasser X-Ray Dosimeter is described in a leaflet issued by the Victoreen Instrument Company, 2825 Chester Ave., Cleveland, Ohio.

Duo-Stat
The results obtained by the use of the Duo-Stat for Hot Water Heating System Control are illustrated in a recent leaflet of the F. I. Raymond Co., 228 N. La Salle St., Chicago, Ill.

Don't Guess—Test!
is the title of a direct mail folder of Herman H. Sticht & Co., 21 Park Row, New York, N. Y., announcing a new model megohmer.

Balance—Quick Weighing
Leaflet P.T.O. of Julean H. Becker, Delft, Holland, illustrates their No. 404 balance, quick weighing type and oil damped. This is printed in English.

Engine Indicator
Tafel 1 of Lehmann & Michels, Hamburg-Altona, Germany, describes their indicator. This is printed in German.

Experimenter
The October issue of the General Radio Experimenter published by the General Radio Company, Cambridge, Mass., contains the following articles: The Development and use of the Hydrophone; A new Test Oscillator; Characteristics of Electrical Pickups; Some old Principals in Audio Amplifier Design.

Gas Analysis Recorders
Pamphlet No. 63-1 of Walker, Crosweller & Co., 54 Queen Elizabeth St., London, S.E. I., England, describes their Gas Analysis Recorders—Arkon Type.

Gas Volume Recorders
Pamphlet No. 64 of Walker, Crosweller & Co., 54 Queen Elizabeth St., London, S.E.I., England, covers the Arkon Gas volume indicators and recorders.

Gauges—Draft and Pressure
Pamphlet No. 58-1 of Walker, Crosweller & Co., 54 Queen Elizabeth St., London, S.E.I., England, illustrates their gauges.

Heat Flow Meter
Trost Brothers, 104 Victoria St., London, S.W.I., England, have issued a leaflet describing an instrument for measuring the loss of heat from insulated surfaces, such as steam pipes, etc.

How the Other Fellow Does It
The Brown Instrument Company have sent out a folder with the above title. This folder is the second of a series illustrating modern heat treating problems and appliances.

Hydrogen Ion Determination
List No. 39 of H. Tinsley & Co., South Norwood, London, S.E.-25, England, is entitled "Hydrogen Ion determination by the Quinhydrone Electrode."

The Laboratory
Volume One, Number Four of the Laboratory published by the Technical Service Department of Fisher Scientific Company, Pittsburgh, contains the following article:

Old Chemistries. English Chemists Analyze Baseball. The Analytical Balance.

Laboratory Apparatus

The General Radio Company, Cambridge, Mass., have recently issued a "Catalog of Laboratory Apparatus" covering the various electrical apparatus and instruments manufactured by them.

Liquid Depth Measurement

Catalog Section 54 issued by Budenberg Gauge Co., Ltd., Broadheath near Manchester, England, illustrates and describes the instruments manufactured by them for depth measurement.

Megohmer

The Model "DM" Megohmer is covered by Bulletin No. 170 issued by Herman H. Sticht & Co., 21 Park Row, New York, N. Y.

Potentiometer Shunts

List No. 38 of H. Tinsley & Co., South Norwood, London, S.E. 25, England, lists their shunts for the measurement of direct current.

Pressure and Vacuum Recorders

Walker, Crosweller & Co., 54 Queen Elizabeth Street, London, S.E.1., England, describe and illustrate their records in Pamphlet No. 65-I.

Productimeter

The folder of the Durant Mfg. Co., 655 Buffum St., Milwaukee, Wis., covers the various types and kinds of counters manufactured by them.

Revolution Counters

Special List No. 2 issued by Irion & Vosseler, Schwenningen Am Neckar, Germany, describes the revolution counters manufactured by this Company. This bulletin is printed in German.

Spectrometric Apparatus

A recent bulletin of Bellingham & Stanley, Ltd., 71 Hornsey Rise, London, N. 19, England, describes and illustrates their Spectrographs.

Tachometers

Catalog 1702 of The Bristol Company, Waterbury, Conn., covers their tachometers for recording and indicating the speed of rotation of any piece of revolving machinery.

Tachometers and Tachographs

A recent bulletin of the Noris-Tachometerwerk, Germany, is being distributed by L. Katzenstein & Co., 117 Liberty St., New York, N. Y. Sole Distributors for the United States.

Thermometers-Recording

"Standard Recording Thermometers" is the title of a bulletin issued by the Standard Thermometer Company, Boston, 19, Mass.

Thermometers-Mechanical

The mechanical thermometers of the Standard Thermometer Company, Boston, 19, Mass., are illustrated and priced in their leaflet covering this.

Thermostats

The various thermostats of the Standard Thermometer Company, Boston, 19, Mass., is covered by a leaflet, which also gives prices.

Things That Count Considerably and Accurately

A leaflet of F. B. Redington Co., 112 S. Sangamon St., Chicago, Ill., illustrates their counters.

Texilscope

The "Texilscope" an instrument for determining the exact fibre content of all textiles is described in a leaflet issued by the Universal "Texilscope" Company, 59 Pearl St., New York, N. Y.

Tycos Rochester

The October issue of Tycos Rochester published by the Taylor Instrument Company, Rochester, N. Y., contains the following: A Thermometer for Every Airplane; Dangers that Lurk in the Family Icebox; High Temperature Recorded in Uncle Sam's Test Fires; Lightning Prefers Oaks; Progress in Practical Meteorology; Tornado and Hailstorm Hazard; Scientific Captains Courageous; Carnegie Scientists Study World Atmospheric Conditions; The Great Blizzard of 1888; and Tycos in the East.

Viscosimeter

A recent leaflet issued by Teschner-Myers Co., Inc., 22 Warren Street, New York, N. Y., describes the Teschner "One Motion" Control Viscosimeter.

Vibrograph

The Vibrograph, an instrument for the study of vibration, is described in a leaflet of Lehmann & Michels, Hamburg-Altona, Germany. This is printed in German.

Vibration Galvanometer

List No. 40 of H. Tinsley & Co., South Norwood, London, S.E. 25, England, illustrates the Schering Vibration Galvanometer.

Water Works Journal

The September issue of the Water Works Journal issued by the Pittsburgh Equitable Meter Company, Pittsburgh, Pa., contains the following: Pennsylvania Railroad's Water Supply System at Altoona, Pa.; History and Progress of Kalispell's Water Department and Classified General Accounting and Ledger Control as used by City of Tampa Water Department.

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Wheatstone Bridges

Standard Wheatstone Bridges of the Plug Pattern are the subject of List No. 13 issued by H. Tinsley & Co., South Norwood, London, S.E. 25.

Correct Principles and Attention to Detail the Secret of Foxboro Supremacy.

Bulletin D.M.F. No. 553 issued by the Foxboro Co., Foxboro, Mass., takes up the distinguishing features of Foxboro recorders.

Daylight Lamp

Bulletin 968 of C. J. Tagliabue Mfg. Co., 18 Thirty-third St., Brooklyn, N. Y., illustrates the New Tag Standard Daylight Lamp. The lamp is adapted for color determinations with the Saybolt or the Tag-Robinson.

Electrical Measuring Instruments

The Sensitive Research Instrument Corp., 142 East 32 St., New York, N. Y., have issued a bulletin to cover their micro-ammeters, millivoltmeters, A. C. Milliammeters and Voltmeters for High Frequency Measurements, etc.

Electrical Measuring Instruments

Catalog No. 16 of the Jewell Instrument Co., 1650 Walnut St., Chicago, Ill., illustrates their very extensive line of electrical instruments.

Flow Indicators

Bulletin No. 204 of Morey, Jones & Lovell, Inc., 922 So. Hemlock St., Los Angeles, Calif., illustrates Series C. M-J-L Flow Indicators for the measurement of gas or liquids.

Hardness Testing Machine

The Pittsburgh Instrument & Machine Co., Pittsburgh, Pa., have issued a bulletin on their new precision hardness testing machine.

Milk Thermometers

The C. J. Tagliabue Mfg. Co., have issued Bulletin No. 963 announcing a new round case recorder with a new mechanism and a new chart.

Scales-Cordage

Circular No. 10 issued by the Amthor Testing Inst. Co., 309 Johnson St., Brooklyn, N. Y., illustrates their direct reading, desk and pocket type, cordage scales.

Thermometers

The Tag Five-Inch Dial-indicating Thermometers are illustrated in Bulletin No. 951 issued by the C. J. Tagliabue Mfg. Co., 18 Thirty-third St., Brooklyn, N. Y.

Automatic Hot-Blast Recording Controller

Circular F-8-P 25, 127 of Leed's & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., covers their automatic Hot-Blast Recording Controller.

Bristol's serves all Industries

is the title of a recent direct mailing of the Bristol Company, Waterbury, Conn.

Better Weaving Warps at Lower Cost

Bulletin 958 of C. J. Tagliabue Co., 18 Thirty-third St., Brooklyn, N. Y., illustrates a number of Tag installations in textile plants.

Bausch & Lomb Magazine

The October issue published by the Bausch & Lomb Optical Co., Rochester, N. Y., contains the following: Orthogen Wide-Vision Lenses; Service—the Key Note of Orthogon Lenses; Here's How.

Bridge—Student's Kelvin

Bulletin No. 434 of Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., describes and illustrates their Student's Kelvin Bridge.

Check-Up!

A leaflet issued by the Weston Electrical Instrument Co., Newark, N. J., covers their Radio D.C. Testing instruments.

Concerning Drying

Bulletin 954 issued by C. J. Tagliabue Mfg. Co., 18 Thirty-third St., Brooklyn, N. Y., is addressed to the financial and managerial groups of the textile industry.

Extensometer System Geiger

Lehmann & Michels, Hamburg-Altona, Germany, have issued a leaflet describing this instrument. This is printed in German.

Engine Indicator

Lehman & Michels, Hamburg-Altona, Germany, have issued a leaflet describing their indicator for locomotives. This is printed in German.

Galvanometer

Bulletin No. 438 of H. Tinsley, South Norwood, London, S.E. 25, England, covers their "Dwarf" galvanometer.

Gas Service Journal

The September issue of the Gas Service Journal, issued by the Pittsburgh Equitable Meter Co., Pittsburgh, Pa., contains: Gas Service Renewed after the Break of St. Francis Dam; Union Gas Corporation, Independence, Kansas; Service Regulators.

Handy Bristol's Recorder

The Bristol Co., Waterbury, Conn., have a small photo-litho copy of their Bulletin No. 363A available.

Long Distance Transmitting and Recording System

The Bristol Co., Waterbury, Conn., have a new bulletin, which describes their long distance transmitting and recording instruments.

Laboratory Equipment

The Palo Company, 153 West 23 St., New York, N. Y., have sent out a direct mail folder covering a number of their newer developments.

Instrument Investment News

The October issue of the above publication issued by the American Schaeffer & Budenburg Corp., 338 Berry St., Brooklyn, N. Y., contains the following articles: A Dairy Saves Money; Is One Bean as Good as Another; The Meat Packer Finds How to Create Profits.

Measuring Machine

The "Zeiss" Measuring Machine is covered by Bulletin C940 issued by Schuchardt & Schuette, 142 Liberty St., New York, N. Y.

Microscope Record

The Microscope Record published by W. Watson & Sons, Ltd., 313 High Holborn, W.C.I., London, England, has the following articles in the September issue: Photomicrography; Development of the Negative; Hints to Beginners; A Message from Mars; Reminiscences of a Microcopist, etc.

Micrometer Compensator for Magnetic Compasses
The Titterington Micrometer Compensator is briefly described in a leaflet issued by the Pioneer Instrument Co., 754 Lexington Ave., Brooklyn, N. Y.

Ohmmeters
Bulletin 1200 of James G. Biddle, 1211 Arch Street, Philadelphia, Pa., covers the "Megger" and "Meg" direct reading Ohmmeters.

Pocket Transit
Bulletin C of Wm. Ainsworth & Sons, 2151 Lawrence St., Denver, Colo., describes the Improved Brunton Patent Pocket Transit.

Price List—Chemicals
J. T. Baker Chemical Co., Phillipsburg, N. J., has issued a price list dated October 1, 1928.

Potentiometers
List No. 44 of H. Tinsley & Co., South Norwood, London, S.E. 25, England, covers their "Concentric Potentiometer." List No. 48 covers their Thermo-electric Potentiometer, List No. 46 their Portable Potentiometer.

Radio Instruments
The Weston Electrical Instrument Corp., Newark, N. J., have issued Circulars J & Y to cover Radio Instruments.

Sampling and Gauging Instruments
Catalog 957 of C. J. Tagliabue Mfg. Co., 18 Thirty-third Street, Brooklyn, N. Y., briefly describes the New Tag Sampling and Gauging Instruments.

Sulphur Dioxide Meter
Circ. 60-G, 5-1028, Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., briefly describes their SO_2 Meter.

Topographical Stereoscope
Pamphlet No. 391, Barr & Stroud, Ltd., Glasgow, Scotland, illustrates and describes their instrument.

Transits & Levels
Wm. Ainsworth & Sons have issued Bulletin B-2 to cover Railroad & Highway Transits & Levels.

Temperature—The Most Vital Factor in Modern Laundry Operation
is the title of Bulletin No. 959 issued by C. J. Tagliabue Mfg. Co., 18 Thirty-third St., Brooklyn, N. Y.

Weights
Ainsworth Precision Weights are illustrated in a direct mail piece of Wm. Ainsworth & Sons, Inc., 2151 Lawrence St., Denver, Colo.

Elasticometer
The Elasticometer is the title of a leaflet issued by the Coats Machine Tool Company, 110-112 West 40 St., New York, N. Y. The Elasticometer is a machine for testing coiled spring for tension and compression.

Instruments
The National Gauge and Equipment Co., La Crosse, Wis., have issued catalogue No. 23 covering the instruments manufactured by them: pressure gauges for automobiles, Ammeters for automobile, Dash Thermometers, Gasoline gauges, Airplane oil gauges and Thermometers, vacuum, vacuum and pressure and pressure gauges.

Mathematical Drawing Instruments
Booklet No. 150 published by A. G. Thornton, Ltd., Manchester, England, illustrates the drawing instruments manufactured by them.

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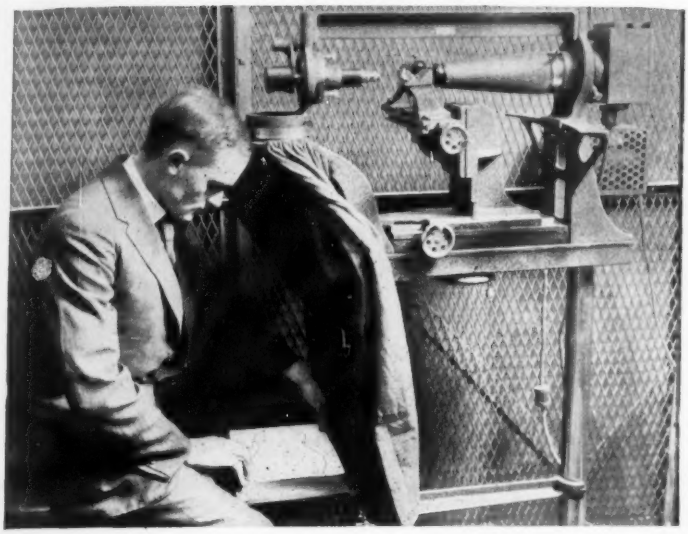

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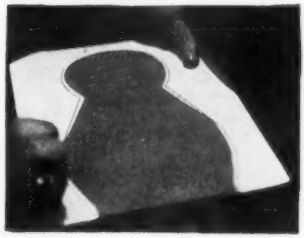

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Current Literature Review

Abstracts on instruments of interest to instrument readers

The Electrical Testing of High Tension Insulators. J. Wallich, Engg. Progress. July 1928, pp. 187-190.

In this article the electrical testing laboratory of the Hermsdorf-Schomburg-Isolatoren, G.M.B.H. is described.

Cathode-ray Oscillographs and Their Uses. E. S. Lee, G. E. Rev. Aug. 1928, pp. 404-412.

The following points are taken up in this article: Principle of the cathode-ray oscillograph; Fundamental types; characteristics; description of the instrument and examples of application.

Reflection of Light by Terra Cotta Surfaces. F. Benford, G. E. Rev. Aug. 1928, pp. 424-431.

Knowledge of the fundamentals of reflection essential to wise choice of material and results of an extensive test are taken up in this article.

Geophysical Methods Applied to Exploration and Geologic Mapping in the Michigan Copper District. T. M. Broderick and C. D. Hohl. Economic Geology. Aug. 1928 pp. 489-514.

The following points are discussed in this article: Principles of geophysical methods and applications of geophysics; Direct application of geophysics to copper finding; Electrical methods; Indirect application of geophysics to copper finding; Application of geophysical methods to geologic mapping.

A New Type of Aquarium Microscope. D. J. Scourfield. Jl. Royal Micro. Soc. June 1928, pp. 129-132.

Instrument briefly described and illustrated.

Mode of Formation of the Image in the Microscope. H. Moore. Jl. Royal Micro. Soc. June 1928, pp. 133-143.

This paper is a discussion of the views set forth by Prof. Berek of Marburg in 1926.

Some Introductory expermients dealing with a quantitative method of determining the resolving power of microscope objectives. B. K. Johnson. Jl. Royal Micro. Soc. June 1928, pp. 144-158.

A number of experiments are described.

Spectroscopic Study of Fuels and Analysis of Detonation Theories. G. L. Clark. Jl. S.A.E. Aug. 1928, pp. 167-173.

This paper reports a continuation, along one line, of experiments described in a previous paper of Clark, Aborn and Brugmann.

Importance of Gas and Gasoline Analysis to the National Gasoline Industry. W. W. Robinson, Jr. Natural Gas. July 1928, pp. 28-30.

The various tests are discussed.

The Flow of Fluids in Pipes. E. S. L. Beale and P. Docksey. Jl. of Inst. Petroleum Technologists. April 1928, pp. 236-262.

The problem is discussed mathematically.

Flow and Measurement of Gases in Pipes. S. J. M. Auld. Jl. of Inst. Petroleum Technologists. April 1928, pp. 263-264.

Mathematical discussion.

The Question of a Light Unit (Hefner or International Candle.) W. Dziobek. Licht und Lampe. Feb. 9, 1928, pp. 77-79.

A discussion of the difficulties attending the adoption of a standard unit of light. The faults of the Hefner lamp led to the adoption of the international candle in 1913. Its accuracy is probably not much better than that of the Hefner, and it has an added disadvantage in that it will be extremely hard to reproduce. The complications due to heterochromatic sources and spectral sensitivity of the eye made the choosing of a standard more of a problem. Five methods of heterochromatic photometry are briefly discussed, and the problems mentioned that each of them introduces: Equal brightness fields, contrast methods, step photometry, flicker principles, and the spectrophotometric system. Kodak Res. Labs. Abs. Bull.

The T. C. B. Photo-colorimeter. J. Pinte. Pulp and Paper. Feb. 9, 1928, pp. 171-173 and Feb. 16, 1928, pp. 201-205.

As a source of light the Philipps "Pointolite" lamp is used. This lamp contains 2 spherical tungsten electrodes and an arc is struck between them and the amount of current is controlled by a resistance. The light from the lamp is thrown on the sample through an optical system and the reflected light is focussed on the window of a photo-electric cell which is connected with a Deprez or d'Arsonval mirror galvanometer and the deflections are read off. Filters made by the Eastman Kodak Co. are used. Applications of the instrument are discussed. Kodak Res. Labs. Abs. Bull.

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Hoyt Electrical Instrument Works, 857 Boylston St., Boston, Mass.

High Frequency Photography for the Analysis of Motion. C. B. Neblette. Photo-Era. June 1928, pp. 360-362.

A summary of the work of Messter, Marey, Bull, Cranz, Heape, Grylls, and Jenkins in the field of ultra-rapid motion pictures. Kodak. Res. Labs. Abs. Bull.

Photomicrography. H. Naumann. Filmtechnik. Sept. 3, 1927, pp. 336-338.

Motion photomicrography with the Ica Universal outfit is discussed and various suggestions for optical adjustments are made. A method whereby a camera with nondetachable objective may be used for photomicrography is explained. Kodak Res. Labs. Abs. Bull.

The Unimeter—A New Instrument for Measuring Transmission and Reflection. L. Block, Licht und Lampe. March 22, 1928, pp. 207-208 and April 5, 1928 pp. 244-247.

Franz, Schmidt, and Haensch are now making a new densitometer which is very versatile. By means of its many adjustments and several attachments it can be used to measure transmission and reflecting power of clear and turbid substances (both solid and liquid), scattered, transmitted, or reflected light, and things of similar nature. The instrument is built around a Marten's polarization photometer and a beam splitter. One beam, before entering the photometer, can be made to take a circuitous path, if desired. Kodak Res. Labs. Abs. Bull.

Standard Method of Preparing Test Sheets. Pulp and Paper. April 5, 1928, pp. 449-456.

Details are given for preparing test sheets to determine initial strength of paper pulp. Kodak Res. Labs. Abs. Bull.

Diffraction of X-rays through a Line Grating. J. Thibaud. Physik. Zeits. May 1, 1928, pp. 241-261.

A paper on the use of the line grating at grazing incidence for the spectrography of X-rays contains a description of the instruments and methods used in the investigation of the gap between the soft X-rays and the ultra-violet. Kodak Res. Labs. Abs. Bull.

Super Microscope for Metallography. Chem. Age. April 18, 1928, pp. 382.

The eyepiece of the microscope is replaced by a second microscope made possible by a special lens placed very close to the objective of the second microscope. It is tested for magnification at 4000 diameters and is made by F. Davidson and Co., London. Kodak Res. Lab. Abs. Bull.

Testing of Machinability. (Bearbeitungspruefungen von Werkstoffen). W. Leyensetter. S.u.E. July 19, 1928, pp. 975-976.

The instrument devised by the author is illustrated and results obtained therewith are given.

Investigations and Control Methods of Rolling Mills. (Untersuchung und Ueberwachungsverfahren der Walzwerke). G. Bulle. Archiv fuer Eisenhuettenwesen. July 1928, pp. 11-18.

Investigation of output by time recorders, review of the results in the operation record. Measurement of power and influence of the rolling process on the quality of the product. Tests on furnaces and the record of capacity, fuel use, combustion, etc.

Some Observations on Aerial Photography. A. Beardsley. Photo-Era, May 1928, pp. 252-257.

The limitations of the use of ground cameras for aerial purposes are pointed out and suggestions are made for obtaining successful photographs.—Kodak Research Labs. Abs. Bull., Aug. 1928.

Astronomical Photography. J. Chappell. Camera Craft, June 1928, pp. 266-270.

The advantages of photographic astronomical observations over the visual are stressed.—Kodak Res. Labs. Abs. Bull., Aug. 1928.

Cinephotomicrography. H. Naumann. Filmtechnik, Sept. 3, 1928, pp. 336-338.

The author gives specific instructions for the setting-up of camera, light source, and microscope. —Kodak Res. Labs. Abs. Bull., Aug. 1928.

Practical Application of Duane's Method in Determining the Quality of X-Rays. L. Mallet and A. Nicolle. Jl. Radiol et. Elec., January 1928, p. 30.

The instrument readings or a Benoist qualimeter does not precisely determine the limiting wave-length or the effective wave-length. Hence the author has designed a copper disk with aluminum steps from 6-30 mm. thick; he describes its use and application. (From Arch. d'Electricite Medicale, etc., June, 1927.)—Kodak Res. Labs. Abs. Bull., Aug. 1928.

A New Photographic Sensitometer. G. Siadbei. Comp. rend., June 11, 1928, pp. 1612-1613.

The instrument is described as a time scale sensitometer in which the photographic material is moved with respect to the light source behind a plate in which are cut slots for exposure varying by the power of two. The light source used as tungsten operating at low color temperature and screened by opal glass.

Report of the Committee on Standardization of X-Ray Measurements of the Radiological Society of North America. Radiology, April 1928, p. 318.

The unit of effective X-ray intensity, one **R**, is defined. Specifications are given for the apparatus and method of measurement. Spectrometric analysis of the X-radiation gives the most complete determination of its quality. The committee recommends that dosage be expressed in terms of **R**-units and time of application, and that the quality be stated in terms of effective wave-length or half-value layer.—Kodak Res. Labs. Abs. Bull. Aug. 1928.

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Portable Recording Wattmeter Saves $2,444 in One Year. H. R. Platt and E. Adams. Power, Sept. 18, 1928, pp. 477-479.

The article describes studies made on the transformer and motor loads, with a curve-drawing wattmeter, showed large power losses that were not apparent before.—M.B.R.

McLaurin Gummed Tape Tester. Paper Trade Jl. April 5, 1928, p. 61.

The tape to be tested is moistened and attached to a piece of kraft paper; after a definite interval, a pendulum exerts a constant pull on the tape. Time of test 15 seconds. Kodak Res. Labs. Abs. Bull.

Hydrogen Ion Measurements in the Pulp and Paper Mill. W. F. Hoffman. Paper Trade Jl. Feb. 23, 1928, pp. 151-157.

Photomicrography for the Amateur. P. M. Mallet. Rev. franc. phot. April 15, 1928, pp. 107-110.

The seventh installment of a description of the necessary apparatus and manipulatory details suitable for amateur photomicrography. Kodak Res. Labs. Abs. Bull.

Shotting the Split Second. F. Westerberg. Amer. Cinemot. June 1928, pp. 20-21.

Athletes racing and stop watch operators do not respond instantly to the gun. Accurate records to 1/25th of a second are secured by mounting a stop watch in front of a motion picture camera focussed on the starting or finishing points. An auxiliary lens brings the watch in focus over half the field. From six to ten picture frames record the pistol smoke before any response from the runners is seen. The number of frames to a fifth of a second is counted from the watch records. An interval of seven frames, or 4/25th sec., elapses between pistol shots and the starting of a stop watch by hand. The method is invaluable for interpreting close finishes. Kodak Res. Labs. Abs. Bull.

Determination of Moisture in Steam by Electrical Conductivity. M. E. Fitze. Power, Sept. 18, 1928, pp. 484-485.

A method of determining the moisture in steam is taken up.—M.B.R.

Selling the Meters in the Industrial Plants. M. J. Hess. Power, Sept. 3, 1928, pp. 488-489.

The importance of having a man in the plant to sell the idea of meters to the men using them. —M.B.R.

Molecular Weights of Saturated Vapors by the Effusion Method. Henry Eyring. Jl. Amer. Chem. Soc., Sept. 1928, pp. 2398-2401.

Apparatus and method for the rapid determination of molecular weights of saturated vapors are outlined.—M.E.H.

A Precision Pipet Viscometer. S. W. Ferris. Ind. Engg. Chem., Sept. 1928, pp. 974-977.

A pipet viscometer entirely of glass has been developed by which the Saybolt viscosity of an oil may be determined on small samples with an accuracy higher than ordinary results from the Saybolt instrument itself.—M.E.H.

Modified Apparatus for Determination of Sulfur in Iron and Steel. M. H. Steinmetz. Ind. Engg. Chem., Sept. 1928, p. 983.

This has the advantage of a specially constructed condenser whereby all the hydrochloric acid and the water vapor are returned to the evolution flask while the hydrogen sulfide passes over freely to the absorbent.—M.E.H.

The Measurement of Capacitance in Terms of Resistance and Frequency. J. G. Ferguson and B. W. Bartlett. Bell Jl., July 1928, pp. 420-437.

The adaptation of a bridge circuit due to M. Wien together with apparatus and procedure is described which permits measurement of capacitance in terms of resistance and frequency with an accuracy comparable to that of the primary standards. The method is also applicable to the determination of inductance since its unit, like that of capacitance, may be derived from the units of resistance and frequency.

The Chemist in the Electrical Industry. G. Parlour, C. H. Crowe. Can. Chem., Aug. 1928, pp. 224-226.

Inspection and analysis of Raw Materials. Control of Shop Processes. Research work.

The Contouring of Smooth Surfaces. J. P. Andrews. Jl. Scientific Insts., July 1928, pp. 209-213.

By the employment of a very narrow intense beam of light, the shapes of smooth surfaces may be investigated. This paper describes appropriate experiments, and gives the necessary calculations for regular spherical and cylindrical lens-surfaces; a complete, nearly circular cylinder; and a metal surface of no prescribed figure. The application to glazed porcelain surfaces is alluded to; and it is shown that an accuracy comparable with that of an interference method is attainable by this method.—M.B.R.

The Errors of a Reflecting Prism. T. L. Baker. Jl. Opt. Soc., 1927-28, No. 4, pp. 187-193.

A prism with two reflecting faces designed to fulfill a particular purpose in an optical instrument gives rise to errors due to (a) inaccuracy of manufacture and (b) inaccuracy in mounting the prism in the instrument. The effects of these errors are investigated.

The special case of the constant deviation prism, in which the three parts of the ray inside the prism nominally lie in a plane, give rise to an error of the second order, the value of which is obtained.

Review of Recent Patents

Printed copies may be obtained at the cost of 10 cents by addressing the Commissioner of Patents, Washington, D. C.

THERMOSTATIC ELECTRIC SWITCH. Herbert J. Sauvage, Chicago, Ill., assignor to Trustees of The Electro Thermostatic Control Co. Pat. No. 1,675,138.

THERMOSTATIC CONTROL. Dirk Eisinger, Los Angeles, Calif. Pat. No. 281,371.

ELECTRICITY METER. Sebastian Ziani de Ferranti, assignor to The Ferranti, Ltd. Pat. No. 281,452.

FLOW METER. Charles M. Anderson, Salt Lake City, Utah. Pat. No. 281,527.

ELECTRICAL MEASURE. John W. Legg, Wilkinsburg, Pa., assignor to The Canadian Westinghouse Co. Pat. No. 281,633.

AUDIBLE SPEED INDICATOR. Karl Gunnar Magni, Linkoping, Sweden, assignor to Aktiebolaget Baltic. Pat. No. 1,678,402.

GYROSCOPIC COMPASS. William R. Height, Hollis, N. Y., assignor to The Sperry Gyroscope Company. Pat. No. 1,686,524.

THERMOSTATIC REGULATOR. August J. Mottlau, Pittsburgh, Pa., assignor to Westinghouse Elec. & Mfg. Co. Pat. No. 1,686,634.

ELECTRIC MEASURING INSTRUMENT. Walter G. Neyphies, Wilkinsburg, Pa. and Bert C. La Bar, Turtle Creek, Pa. assignors to Westinghouse Elec. & Mfg. Co. Pat. No. 1,686,635.

SLIP INDICATOR. Raymond T. Pierce, Swissvale, Pa., assignor to Westinghouse Elec. & Mfg. Co. Pat. No. 1,686,638.

ELECTRICAL MEASUREMENT INSTRUMENT. Raymond T. Pierce, East Pittsburgh, Pa., assignor to Westinghouse Elec. & Mfg. Co. Pat. No. 1,686,639.

WATTHOUR METER. Argyle R. Rutter, East Pittsburgh, Pa., assignor to Westinghouse Elec. & Mfg. Co. Pat. No. 1,686,641.

ELECTRICAL MEASURING INSTRUMENT. Joseph W. Legg, Wilkinsburg, Pa., assignor to Westinghouse Elec. & Mfg. Co. Pat. No. 1,686,669.

PRESSURE METER. Carl J. Fechheimer, Pittsburgh, Pa., assignor to Westinghouse Elec. & Mfg. Co. Pat. No. 1,686,688.

VOLTMETER. Charles Le G. Fortescue, Pittsburgh, Pa., assignor to Westinghouse Elec. & Mfg. Co. Pat. No. 1,686,689.

ELECTRICAL MEASURING INSTRUMENT. Argyle G. Rutter, Forest Hills, Pa., assignor to Westinghouse Elec. & Mfg. Co. Pat. No. 1,686,712.

TWIST METER. John Hammond Smith, Pittsburgh, Pa. Pat. No. 1,686,714.

ELECTRICAL MEASURING INSTRUMENT. William M. Bradshaw, Wilkinsburg, Pa., assignor to Westinghouse Elec. & Mfg. Co. Pat. No. 1,686,727.

SEMAPHORIC INDICATOR. William P. Dalyrimple, Chicago, Ill. Pat. No. 1,686,735.

THERMOSTATIC CONTROL SYSTEM. Herbert J. Sauvage, Chicago, Ill., assignor to trustee of the Electro Tachometer Control Company. Pat. No. 1,686,766.

ODOMETER. John Hays Hammond, Jr., Gloucester, Mass., and Alfred D. Trenor, New York, N. Y., said Trenor assignor to said Hammond. Pat. No. 1,686,854.

MEASURING TAPE. Clinton H. M. Bull, Houston, Tex., assignor to Reed Roller Bit Co. Pat. No. 1,686,956.

THERMOSTAT. Wellington J. Smith, Cleveland, Ohio. Pat. No. 1,687,230.

ENGLISH PATENTS

MESSVORRICHTUNG FUER SCHUETTGUT. Wilhelm Ponndorf, Kassel, Germany. Pat. No. 459,061.

NEIGUNGSWAAGE. Carl Jolas, Hanover, Germany. Pat. No. 459,163.

ALS NEIGUNGSWAAGE AUSGEBILDETE WAAGE DER ROBERVALSCHEN ART. Toledo Scale Co., Toledo, Ohio. Pat. No. 459,164.

FAHRZEUG, BEI DEM ZWISCHEN UNTERGESTELL UND AUFBAU EINE FEDERWAAGE EINGESCHALTET IST. I. Klejniak, Duisburg-Hachfeld, Germany. Pat. No. 459,165.

ANZEIGEVORRICHTUNG ZUR ERMITTLUNG DES PRODUKTS ZWEIER GROESSEN UNTER VERWENDUNG LOGARITHMISCHER SKALEN. L. Garapon, Villeurbanne, France. Pat. No. 459,166.

WAAGE AN AUSLEGERKRANEN. Albert Essmann, Altona-Othmarschen, Germany. Pat. No. 458, 812.

VORRICHTUNG ZUR MIKROSKOPISCHEN UNTERSUCHUNG DER WANDUNGEN VON ENGEN HOHLRAEUMEN IN PERLEN, KLEINEN WERKSTUECKEN, UDGL. Firma C. Reichert, Wien, Austria. Pat. No. 458,813.

VERFAHREN UND EINRICHTUNG ZUM PRUEFEN DER LAGE ZWEIER ACHSENRICHTUNGEN. Firma Carl Zeiss, Jena, Germany. Pat. No. 458,814.

ROEHRENFEDERTHERMOMETER MIT FUELLUNG AUS ZWEI FLUESSIGKEITEN IN TAUCHGEFAESS. Steinle & Hartung, Quedlinburg, Germany. Pat. No. 458,926.

The Theory of Aplanatic Surfaces. T. Smith. Jl. Opt. Soc., 1927-28, No. 4, pp. 179-186.

The necessary and sufficient condition that an optical system should have a pair of aplanatic surfaces is that the eikonal of the system can be expressed as a homogeneous function of the first order of three variables, each of which is a linear function of the direction cosines of the ray in the object and image spaces. Methods are given for finding the equations of these surfaces when the eikonal is given, and for finding the eikonal when the surfaces are given. Conjugate aplanatic surfaces are similar apart from arbitrary uniform unidirectional extensions or compressions.

In general only one pair of aplanatic surfaces is possible, but in spherically symmetrical systems two pairs are found. In addition there may be aplanatic imagery at isolated points.

A Universal X-Ray Photogoniometer. J. D. Bernal. Jl. Sc. Insts., August 1928, pp. 241-250.

Detailed description of the X-ray Photogoniometer is given.

The Thermal Expansion of Fireclay Bricks. Albert E. R. Westman. Bulletin No. 181, Engg. Exp. Sta., Univ. of Illinois.

This bulletin is the report of an investigation of the thermal expansion and correlated properties of twenty brands of fireclay brick.

A Laboratory Furnace for Testing Resistance of Fire Brick to Slag Erosion. R. K. Hursh and C. E. Grigsby. Circular No. 17, Engg. Exp. Sta. University of Illinois.

This circular contains a description of the slagging test furnace developed at the University of Illinois and gives methods of conducting tests with the furnace.

Flow of Brine in Pipes. R. E. Gould and M. L. Levy. Bulletin No. 182, Engg. Exp. Sta., Uni of Illinois.

This bulletin contains the results of an investigation the purpose of which was to determine the relation between the friction factor and Reynold's number when commercial calcium chloride brine is circulated in standard wrought iron pipe under the conditions encountered in refrigeration practice, and also to determine the viscosity of commercial chloride brine.

A Simple Ultra-Violet Fluorophotometer. B. T. Squires and J. H. Jeffree. Jl. Sc. Insts. Sept. 1928, pp. 273-277.

A simple apparatus is described by which the fluorescence under ultra-violet light of various solutions may be compared with considerable accuracy.

A Simple High-Speed Rotary Pump. L. E. Bayliss and E. A. Miller. Jl. Sc. Insts. Sept. 1928, pp. 278-279.

A small rotary pump is described, suitable for liquids or gases, in which the fluid is forced through a rubber tube by the pressure of a series of rollers passing along it.

A Long-Period Galvanometer. D. C. Gall. Jl. Sc. Insts., Sept. 1928, pp. 280-281.

The magnetic properties of a galvanometer coil are used to increase its periodic time instead of decrease it as is usually the case.

A Universal X-Ray Photogoniometer. J. D. Bernal. Jl. Sc. Insts., Sept. 1928, pp. 281-290.

Continued from August 1928, page 250.

Measuring Standards of Length with Light. H. Simon. Engg. Prog. Oct. 1928, pp. 265-269.

This article shows how reference standards and other parts are measured directly by means of light interference within limits of less than a millionth of an inch.

500 KV Cable Testing Plant. A. Levi & G. Erengi. Engg. Prog. Oct. 1928, pp. 275-281.

The switching arrangements are described in this article.

A Cathodeoscillograph of High Sensitivity. (Ueber einen Kathodenoszillographen hoher Spannungsempfindlichkeit). E. Sommerfeld. Arch. Elekt. Sept. 17, 1928, pp. 607-619.

The instrument is described in detail.

Sensitive Glowing Cathode Oscillograph for Internal Measurements in Cacuum. (Empfindlicher Gluehkathodenoszillograph fuer IInnenaufnahmen in einem Vorvakuum). W. Rogowski, E. Somerfeld W. Wolman. Arch. Elekt. Sept. Sept. 1, 1928, pp. 619-624.

Arrangement is described.

A simple Arrangement for Stroboscopic Investigations. (Eine einfache Anordnung fuer stroboskopische Untersuchungen). H. E. Linckh & R. Vieweg. Zeitz. Instrumenk. Sept. 1928, pp. 416-421.

The arrangement is briefly described.

The Flattening of Steel Balls and Cylinders by the Measuring Pressure. (Die Abplattung von Stahlkugeln und zylindern durch den Messdruck). G. Bernat. Zeits. Instrumentenk. Sept. 1928, pp. 422-432.

Formulae are derived for this flattening.

Maxwell-Thompson Method for Absolute Capacity Measurement. (Zur Maxwell-Thompsonschen Methode der Absoluten Kapazitaetsbestimmung). R. Skancke. Zeits. Instrumentenkunde. Sept. 1928, pp. 432-438.

Two instruments for this purpose manufactured by R. Jung are described.

GESCHWINDIGKEITSMESSER, MIT UMLAUFENDER TROMMEL UND DARIN SICH BELDENDEM FLUESSIGKEITSRING DEUTSCHE. Versuchsonstalt fuer Luftfahrt, Berlin, Germany. Pat. No. 459,226.

STAHLBANDMASS. Werdauer Messwerkzengfabrik, Werdau, Germany. Pat. No. 459,409.

ZENTRIERMIKROMETER MIT ALLSEITIG VERSCHWENKBARER KOERNERSPITZE. G. Beuttler, Muenchen, Germany. Pat. No. 459,436.

MIKROSKOPOBJEKTIV. Charles Spierer, Genf, Switzerland. Pat. No. 459,439.

VORRICHTUNG ZUM ANZEIGEN EINER KLEINEN LINEAREN BEWEGUNG DURCH EINE STARK UEBERSETZTE DREHBEWEGUNG. J. Finne & F. Smith, Aas, Norway. Pat. No. 459,560.

VORRICHTUNG ZUM REDUZIEREN DER ANGABEN EINES HEIZWERTMESSERS AUF EINEN BESTIMMTEN NORMALZUSTAND. H. Junkers, Dessau, Germany. Pat. No. 459,743.

GEFAESS FUER CHEMISCHE UNTERSUCHUNGS UND MESSVERFAHREN. J. Lindner, Innsbruck, Germany. Pat. No. 459,627.

EINRICHTUNG ZUM KONSTANTHALTEN DER GASZUFUHRMENGE BEI VORRICHTUNGEN ZUR BESTIMMUNG DER BESTANDTEILE VON GASGEMISCHEN. Ados, Aachen, Germany. Pat. No. 459,718.

EINSTELLBARES KURVENLINEAL. Karl Schmieder, Dresden, Germany. Pat. No. 460,099.

DOPPELMIKROSKOP FUER RAUMBILD MESSGERAETE. R. Hugershoff, Dresden, Germany. Pat. No. 459,863.

KREISELKOMPASS. Sperry Gyroscope Co., Brooklyn, N. Y. Pat. No. 459,864.

SEXTANT. A. Marcuse and P. Rinkel, Berlin-Charlottenburg, Germany. Pat. No. 459,865.

BADETHERMOMETER. A. Thierfelder, Leipzig, Germany. Pat. No. 460,100.

VORRICHTUNG ZUR MESSUNG VERAENDERLICHER KRAEFTE. J. Paulin, Stockholm, Sweden. Pat. No. 459,866.

UMSCHLAGWINKEL. B. Maether, Schoenwalde, Germany. Pat. No. 460,296.

EINRICHTUNG ZUM SELBSTTAETIGEN SORTIEREN VON ROEHREN ODER STAEBEN, INBESONDERE AUS GLASS. Hyalos, S.A., Schaffhausen, Switzerland. Pat. No. 460,297.

VORRICHTUNG ZUM SELBSTTAETIGEN ANZEIGEN DER BEI EINER NEIGUNGSWAAGE AUFGEGEBENEN ZUSATZGEWICHTE. E. Burman Rotterdam, Holland. Pat. No. 460,500.

MESSGERAET FUER DEN ABGASVERLUST VON FEUERUNGEN. G Berling, Welper, Germany. Pat. No. 460,-236.

MATERIALPRUEFMASCHINE MIT EINRICHTUNG ZUR MESSUNG DURCH MESSWAAGE UND MESSDOSE, ODGL. Losenhausenwerk, Duesseldorf, Germany. Pat. No. 460,415.

EINRICHTUNG ZUM ERSCHUETTERUNGSFREIEN AUFSTELLEN VON MESSINSTRUMENTEN. R. Mueller, Berlin, Germany. Pat. No. 460,543.

VERFAHREN UND EINRICHTUNG ZUM MESSENDEN VERGLEICHEN LICHTSTREUENDER MEDIEN. F. Schmidt & Haensch, Berlin, Germany. Pat. No. 460,587.

VORRICHTUNG ZUM EINREGELN DER ZUFUHR WAEHREND DER NACHFUELLUNG BEI SELBSTTAETIGEN WAAGEN MIT FOERDERVORRICHTUNG. C. Reuther & Reisert, Hennif, Germany. Pat. No. 460,855.

VAKUUMMETER MIT PENDELARTIG AUFGEHAENGTEM QUECKSILBERGEFAESS. Siemens-Schuckertwerke, Berlin, Germany. Pat. No. 460,770.

INDIKATOR. J. Coenders, Traar, Germany. Pat. No. 460,718.

DURCH SCHRAUBZWINGEN ODGL. UNVERRUECKBAR ZU BEFESTIGENDES MESSGERAET ZUM REGISTRIEREN VON DYNAMISCHEN, RASCH WECHSELUDEN DEHNUNGEN UND SPANNUNGEN AN BRUECKEN UND AEHNLICHEN BAUWERKEN. J. Geiger, Augsburg, Germany. Pat. No. 460,719.

VORRICHTUNG ZUR BESTIMMUNG DER AMPLITUDE EINER BELIEBIGEN HARMONISCHEN SCHWINGUNG. L. Martens, Moscow, Russia. Pat. No. 461,061.

AUS DREI POSITIVEN BESTANDTEILEN BESTEHENDES OKULAR MIT GROSSEM GESICHTSFELD. C. P. Goerz, A.G., Berlin, Germany Pat. No. 461,062.

SPHAERISCH, CHROMATISCH UND ASTIGMATISCH KORRIGIERTES PHOTOGRAPHISCHES OBJEKTIV. Rueo-Optik & H. Hahn, Ruedersdorf, Germany. Pat. No. 461,083.

MIKROSKOP MIT BELEUCHTUNGSVORRICHTUNG. R. Plagwitz, Berlin, Germany. Pat. No. 461,261.

FUTTERAL MIT SCHLEUDEREINRICHTUNG FUER THERMOMETER. F. Malina, Weinboehla, Germany. Pat. No. 460,951.

THERMOMETER ODGL. Taylor Instrument Cos., Rochester, N. Y. Pat. No. 461,098.

ECKZIRKEL. C. Collatz, Stettin, Germany. Pat. No. 461,579.

FLUEGELRADWASSERMESSER. Compagnie pour la Fabrication des Compteurs, Seine, France. Pat. No. 461,330.

KONDENSGEFAESS FUER DAMPFMESSER. Siemens & Halske, Berlin, Germany. Pat. No. 461,665.

VORRICHTUNG ZUM GLEICHZEITIGEN BEOBACHTEN EINES FERNEN GEGENSTANDES UND EINES AM INSTRUMENT ANGEBRACHTEN VERGLEICHSGESICHLSFELDES. W. Thorner, Berlin, Germany. Pat. No. 453,745.

WAERMEMENGENZAEHLER FUER WARMWASSERHEIZUNGEN. K. Lietz, Frankfurt A.M., Germany. Pat. No. 461,777.

VERSTELLBARE GRENZLEHRE. Mauser-Werke, Oberndorf, Germany. Pat. No. 462,109.

MESSGERAETE, RICHTMITTEL FUER SCHUSSWAFFEN. C. P. Goerz, A.G., Pressburg, Germany. Pat. No. 462,172.

RICHTUNGS UND KURVENANZEIGER FUER BEWEGTE KOERPER, LUFTFAHRZEUGE, UDGL. Gyrorector, Berlin, Germany. Pat. No. 461,915.

MESSINSTRUMENT MIT AUF EINEM DREHKNAUF GELAGERTEM SCHLEPPANZEIGER. Hartman & Braun, Frankfurt, A.M., Germany. Pat. No. 462,070.

A Momogram with Circular Shaped Reading Line. (Ueber ein Rechenbild mit kreisfoermiger Ableselinie). A. Fischer. Zeits. Vermessungswesen. Oct. 15, 1928, pp. 636-640.

Nomogram described.

The Instruments of the Aerotopograph G. m. b. H. for Aerial Photography. H. Gruner. Bildmessung und Luftbildwesen. Sept. 1928, pp. 110-119.

Instruments described and illustrated.

Aerial Photography and Aerial Photographic Surveying: Aids for the exploration of unexplored lands. (Luftbild und Luftbildmessung: Helfsmittel fuer die Erforschung und bautechnische. Planung in unerschlossenen Laendern). K. Slawik. Allgemeine Vermessungs-Nachrichten. Aug. 29, 1928, pp. 553-564.

bstract of a paper read before the Ausseninstituts of the Technischen Hochschule Berlin.

A Special Case of Co-ordinate Transformation for Different Type Measurements. (Ein Sonderfall der Koordinatenumformung fuer ungleichartige Messungen). Allemeine Vermessungs-Nachrichten. Sept. 26, 1928, pp. 617-626.

Standardization and Types of Theodolites and Levels. (Zur Frage der Normung und Typund von Theodoliten und Nivellierinstrumenten). R. Fennel. Allgemeine Vermessungs-Nachrichten. Sept. 26, 1928, pp. 626-630.

The article considers this subject in detail.

Angle Measurement, Accuracy of Angle Measurement and Angle Error in Polygons for City and Field Measurements. (Die Winkelmessung, die Winkelmessungsgenavenauigkeit und der Winkelfehler in Polygonzuegen fuer Stadt und Flurmessungen). Allegmeine Vermessungs Nachrichten. Oct. 10, 1928, pp. 649-658; Oct. 17, 1928, pp. 667-673; Oct. 24, 1928, pp. 681-686.

Improvement on Sartorius Avalytical Balances. (Neuerangen an Sartorius Analysenivaagen). E. Loewenstein. Zeits fuer Feinmechanik. Sept. 15, 1928, pp. 1-4.

These improvements are described.

Testing of Metals for Torsionaloscillations. (Pruefung von Metallen auf Drehschwengungen). J. Oelschlaeger Zeitschrif fuer Feinmechanik. Sept. 28, 1928, pp. 1-3.

Method of making measurements taken up.

Several Nomograms and other Aids for Aerial Photography. (Einige Nomogramme und andere Helfsmittel fuer die Luftbildmessung). O. Lacmann. Zeits. Vermessungswesen. Aug. 15, 1928, pp. 497-502 and Sept. 1, 1928, pp. 529-546.

The nomograms and other aids are described in the article.

The Development of Aerial Photographic Evaluation Instruments in Germany. O. Eggert. Zeits. f. Vermessungswesen. Oct. 1, 1928, pp. 593-609 and Oct. 15, 1928, pp. 625-636.

The instruments and their development is taken up.

The Location of Surveying Reference Marks in City Streets. (Unterbringung von Vermessungsmarken in staedtischen Strassen). Zeits. Vermessungswesen. Oct. 1, 1928, pp. 614-616.

Method is briefly described.

Tests of the Effect of Brackets in Reinforced Concrete Rigid Frames. F. E. Richart, B. of S. Jl. Res., Aug. 1928, pp. 189-253.

This paper contains results of analyses and tests of rigid frames of reinforced concrete with and without enlargements (termed "brackets") at the intersection of the horizontal top member with the vertical legs.

The Williams Plasticity Press. Rubber Age, Oct. 25, 1928, p. 87.

This paper describes a device for studying the consistency of rubber stacks.

A Sonic Interferometer for Measuring Compressional Velocities in Liquids: A Precision Method. A. L. Loomis and J. C. Hubbard, Jl. Opt. Soc., Oct. 1928, pp. 295-307.

This paper describes an instrument developed by the authors for the precise determination of the velocity of high frequency compressional waves in liquids.

Period of a Loaded Conical Jolly Balance Spring. R. B. Abbott, Jl. Opt. Soc., Oct. 1928, pp. 318-322.

An expression for the period of a conical Jolly balance spring is deduced theoretically and the result is verified by experimental data.

EINRICHTUNG ZUR ABSATZWEISEN STEUERUNG DES FARBBANDTRAEGERS BEI MEHRFARBSCHREIBERN MIT PUNK FOERMIGER AUFZEICHNUNG. Hartman und Braun, A. G. Frankfurt, A.M., Germany.

FLUESSIGKEIT ZUR VORFUEHRUNGEN VON MESSWERKZENGEN FUER MINERALOELE. Martini & Hueneke Maschinenbau Akt Ges., Berlin, Germany.

MESSGERAET ZUR BESTIMMUNG DES WAERMEANSPRUCHES DER UMGEBUNG. Carl Dorns, Davos-Platz, Switzerland. Pat. No. 457,543.

STATIVKOPF. Firma Eugen Ising, Bergnenstat, Rhld., Germany. Pat. No. 458,352.

VORRICHTUNG ZUM AUFZEICHNEN VON QUERPROFILEN. Carl Zeiss. Pat. No. 458,356.

DREHWAAGE NACH EOTOS. S. Rybar, Budapest, Vienna. Pat. No. 458,354.

VORRICHTUNG ZUM ENLASTEN EINER BRUECKENWAAGE, inbesordere in Verbindung mit einer Kraulaufkatze. F. Dondelinger, Bettemburg, Germany.

VERFAHREN ZUR QUANTITATIVEN BESTIMMUNG DER SCHEERFE ODER SCHNEIDFAEHIGKEIT UND DER DAUERHAFTIGKEIT, DER SCHNEIDFLACHEN VON KLINGEN, WERKZEUGEN, ETC. Katara Honda, Sendai, Japan. Pat. No. 458,052.

RECHNENMASCHINE FUER ALLE VIER RECHENARTEN. Rheinische Metallwaren und Maschinenfabrik Soemmerda. A. G. Soemmerda, Germany. Pat. No. 457,868.

VORRICHTUNG ZUR ZWANGSWEISEN RUECKFUEHRUNG DER ZEHNERSCHALTHEBEL BEI RECHENMASCHINEN ODGL. Aktiebolaget Original-Odhner, Goeteborg, Germany. Pat. No. 457,824.

ELEKTROMOTORISCHER ANTRIEB FUER RECHENMASCHINEN. Firma Hans Sabielny, Dresden, Germany. Pat. No. 457,825.

STATIV. Andre Leon Victor Clement Debrie, Paris, France. Pat. No. 458,547.

LANGBASIS ENTFERNUNGSMESSER. Ges. fuer Elektrische Apparate M.B.H., Berlin-Marienfelde, Germany. Pat. No. 458,548.

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EINRICHTUNG ZUM EINSTELLEN DES AZIMUTS BEI DREHWAAGEN. Gebrueder Hoff., G.M.B.H., Pfronten-Ried, Germany. Pat. No. 458,555.

NACH ABSCHLUSS DER WAEGUNG SELBSTTAETIG ANGELASSENE PACKVORRICHTUNG AN SELBSTTAETIGEN BRUTTO-WAAGEN. Hennefer Maschinenfabrik C. Reuther & Reisert, M.B.H., Hennef, Sieg., Germany. Pat. No. 458,743.

ZEILFERNROHR MITS BELEUCHTUNGSVORICHTUNG. Adolf F. Gerdes, Berlin, Germany. Pat. No. 458,718.

VERFAHREN ZUR BESTIMMUNG DER FEUCHTIGKEIT VON KOHLEN UND AEHNLICHEN FESTEN STOFFEN. H. Heinicke, Seehof, Germany. Pat. No. 458,927.

INDIKATOR FUER SCHNELLAUFENDE MASCHINEN. Jan Szal, Gentilly, France. Pat. No. 458,772.

VORRICHTUNG ZUR GASPRUEFUNG, INBESONDERE FUER RAUCHGAS. Siemens & Halske. Pat. No. 458,773.

EINRICHTUNG ZUM AUFZEICHNEN VON MESSERGEBNISSEN PERIODISCH ARBEITENDER, VON WASSER ODER EINER ANDEREN FLUESSIGKEIT ANGETRIEBENER GASUNTERSUCHUNGSAPPARATE. Union Apparatebaugesellschaft, Karlsruhe, Germany. Pat. No. 458,815.

PENDELDYNAMOMETER. Siemens-Schuckertwerke, A.G., Berlin, Germany. Pat. No. 461,916.

PENDELVERDREHUNGSMESSER. A. C. Spark Plug Co., Flint, Mich. Pat. No. 462,071.

ABNEHMBARE HAENGEWAAGE. Toledo Scale Company, Toledo, Ohio. Pat. No. 460,856.

STANDLINIEN ENTFERNUNGSMESSER. Carl Zeiss, Jena, Germany. Pat. No. 458,550.

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Spring Manometers and Thermometers (Federmanometer und Thermometer). D. Wohlfarth. Messtechnik, Sept. 22, 1928, pp. 239-243.

This article covers: properties of the spring manometer, accuracy, increase in life due to systematic choice of material or by lengthening of the spring, operating method of the spring thermometer, description of recording apparatus.

Krupp Microtast Devices (Kruppsche Mikrotastgeraete). Zeits fuer Feinmechanik, October 15, 1928, pp. 1-3.

These gauges are described and illustrated.

Pendulums for Special Purposes. (Pendel fuer besondere Zwecke.) Zeits fuer Feinmechanik, July 28, 1928, pp. 3-7.

Uses of pendulums is briefly mentioned. Seismographs are discussed.

History and Theory of the Iris Diaphragm. (Geschichte und Theorie der Irisblende.) K. Pritschow Zeits fuer Feinmechanik, Aug. 14, 1928, pp. 1-4, and Aug. 27, 1928, pp. 1-3.

This article covers the history, theory, and installaation of the diaphragm in the objective.

The New Magnetic Tests of Wire. J. D. Brunton, Wire and Wire Products. October 1928, pp. 332-335, 354.

This article gives a means of testing steel wire for all defects in composition and drawing, and for testing it at high speed.

Standard Tools for Gauging and Measuring Wire. Wire & Wire Products. Oct. 1928, pp. 336-337.

Types of instruments briefly described and illustrated.

Standard Solar Wave Lengths. K. Burns, W. Meggers and C. Kiess, B. of S. Jl. Res. Sept. 1928, pp. 297-317.

In order to determine a series of solar wave lengths in the international system to serve as standards for a new table of solar wave lengths and to find the exact corrections, which should be applied to Rowland's classical table of solar spectrum wave lengths, the Bureau of Standards and the Allegheny Observator ycooperated in measuring the wave lenegths corresponding to selected dark (Fraunhofer) lines in the solar spectrum. The wave lengths were compared with those of standard neon lines by the Fabry and Perot étalon-interferometer method, both spectra being photographed simultaneously.

Test Stand for Ventilators (Pruefstand fuer Ventilatoren.) R. Mueller Messtechnik, Sept. 22, 1928, pp. 237-239.

This article takes up method of testing, instruments for pressure measurements, methods of measuring, barometer reading, temperature and humidity.

Some Measurements of the Transmission of Ultra-Violet Radiation Through Various Fabrics. W. W. Coblentz, R. Stair and C. W. Schoffstall, B. of S. Jl. Res. Aug. 1928, pp. 105-124.

In this paper measurements are described of the transmission of ultra-violet and visible radiation through fabrics made of various kinds of material—cotton, natural silk, rayon (artificial silk), linen, and wood.

Wear and Mechanical Properties of Railroad Bearing Bronzes at Different Temperatures. H. French, S. Rosenberg, W. Harbaugh and H. Cross. B. of S. Jl. Res. Sept. 1928, pp. 343-421.

A study was made of the wearing and mechanical properties of two groups of copper-tin-lead alloys in both chill-cast and sand-cast conditions. The bronzes were tested under rolling and sliding friction without lubrication at atmospheric and elevated temperatures up to 350° F. (175° C), under both sliding and rolling and sliding friction with lubrication at atmospheric temperatures, and under tension impact, and pounding at temperatures from 70 to 600° F. (20 to 315° C). A detailed description is given of all apparatus used in the test.

No one of the selected laboratory tests yielded information which by itself was adequate for general comparisons.

Elastic Measurements on Copper by Means of Marten's Mirrors (Elastische Messungen an Kupfer Mittels Martensscher Spiegel.) W. Kuntze, Messtechnik, Sept. 22, 1928, pp. 231-236.

This article considers: elastic after-effect, avoidance of this, influence of test loading and stretch, hysteresis, inner stresses, influence of aging.

Tinting Strengths of Pigments. H. D. Bruce. B. of S. Jl. Res., Aug. 1928, pp. 125-150.

In this paper there is presented a discussion of the tinting strength of pigments. It is not primarily proposed herein to offer a new method for estimating and expressing tinting strength, but rather to aid in clarifying ideas on the subject, so that when the science of colorimetrics has been further advanced a rational means for appraising this valuable property may be the more easily developed.

Effect of Clearance and Displacement of Attracted Disk and Also of a Certain Arrangement of Conducting Hoops, Upon the Constant of an Electrometer. C. Snow, B. of S. Jl. Res., Oct. 1928, pp. 513-530.

Formulas are here derived for the force upon the attracted disk of an absolute electrometer. These take account of the clearance between attracted disk and its guard plane, their relative displacement, and the separation of the plates. The effect of using a set of conducting hoops to compensate for the finiteness of the movable plate is also computed.

Differential Pressure Measurement with Orifice, Nozzle and Venturi Tube and Their Choice (Die Druckunterschied-Messung mit Messrand, Duese and Venturirohr und ihre Auswahl). A. Grunwald and F. Engel, Siemens-Zeitschrift, Sept. 1928, pp. 553-562.

This article considers the various devices.

Contents of Subsequent Issues

Historical Sketches of Men who have contributed to the advancement of the Instrument Science.

Dilatometry.

Temperature Control in Process Industries.

Correct Connections for Polyphase Watt Meters.

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Why Flyers Need Instruments.

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The Importance of Measurements in the Power Plant.

Equipment Used in Aerial Surveying.

Automatic Control of High Temperatures.

Instruments for Geodetic Prospecting.

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Comparison of Instruments for Measuring Hardness.

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HANDBOOK OF CHEMISTRY AND PHYSICS. *Charles D. Hodgman and Norbert A. Lange.* Chemical Rubber Publishing Co., 1928. 5x7 Cloth, 1214 pp. $5.50 postpaid.

REVIEWED BY M. BERG RIMBACH

Thirteenth Edition of the handbook, which is a compilation of various authoritative collections of data and from current journals.

The section of the book dealing with specific gravity of aqueous solutions has been completely revised and enlarged. A section devoted to ceramics has been added. Other additions are ethyl alcohol tables giving the specific gravity of aqueous solutions referred to water and data on sound absorption.

HISTORY OF RADIO TELEGRAPHY AND TELEPHONY. *G. G. Blake.* Chapman & Hall, Ltd., 1928. 6x9 Cloth, 425 pp., 197 figs. $7.50 postpaid.

REVIEWED BY MAX HARTENHEIM

Contents: Growth of Electrical Signalling Systems. Development of the Telephone. First Attempts at Wireless Communication. Electro-Magnetic Waves. Wave-Responding Devices of the Coherer Type. Magnetic Detectors. Electrolytic and Crystal Detectors. Dawn of Practical Radio-Telegraphy. Further Investigation. Employment of Ether waves of shorter wave-length than those discovered by Hertz, for Radio Telegraphy and Telephony. Spark and Arc Generators of High-Frequency Currents. Multiple Arc, Hydrogen Arc, Mercury Vapour, and some other methods of producing High-Frequency Oscillations. Various Types of Microphone. Methods of Recording Transmission of Photographs, Experiments in Television, Radio-Dynamic Control. Thermionic Valve and some of the Fundamental Valve Circuits. Direction Finding.

Full references are given and the reader is enabled to obtain first-hand information of most of them. The index fills 21 pages and the contents six pages. These two parts are arranged so that the reader may readily and rapidly turn without difficulty to any section of the volume in which he may be interested.

This book presents a vast amount of historical information concerning wireless communication in clear and concise form, and should therefore prove valuable to those who wish to gain a general insight into the development of wireless communication.

CHEMICAL ENGINEERING CATALOG. The Chemical Catalog Company, Inc., New York, N. Y. 1928, 1107 pp. $3.00 postpaid.

REVIEWED BY RICHARD RIMBACH

The book is an excellent reference work for engineers and others who buy and specify equipment and materials in the chemical industries. It presents the condensed catalogues of 625 companies; a number of instrument companies are among these.

CONDENSED CATALOGUES OF MECHANICAL EQUIPMENT. The American Society of Mechanical Engineers, New York, N. Y. 1021 pp. $5.00 postpaid.

REVIEWED BY RICHARD RIMBACH

The Eighteenth Annual Edition of this book contains the condensed catalogues 561 companies, of which a number are instrument companies.

MEASUREMENT OF AIR FLOW. *E. Ower.* Chapman & Hall, Ltd., 1928. Cloth, 199 pages, $5.00 postpaid.

Review by M. Berg Rimbach on page 11 of August issue of INSTRUMENTS.

THE MICROSCOPE. A SIMPLE HANDBOOK. *Conrad Beck.* R. & J. Beck, Ltd., 1923. Cloth, 144 pages. $1.25 postpaid.

THE MICROSCOPE. AN ADVANCED HANDBOOK. *Conrad Beck.* R. & J. Beck, Ltd., 1924. Cloth, 231 pages. $2.50 postpaid.

THE MODERN CALORIMETER. *Walter P. White.* Chemical Catalogue Company, New York, N. Y., 1928 Cloth, 194 pages, $4.00.

Review by Arthur Schroder on page 9 of the July issue of INSTRUMENTS.

Wave-Length Measurements in the Arc and Spark Spectra of Hafnium. W. F. Meggers. B. of S. Jl. Res., Aug. 1928, pp. 151-187.

Using the purest available samples of hafnium salts the arch and spark spectra characteristic of this element were photographed with concave-grating and quartz-prism spectrographs. Wave-length measurements were made on about 2,100 lines, but 609 of these were discarded as impurities, identified mainly as columbium, zirconium, and titanium. Nearly 1,500 lines remain to describe the hafnium spectra between the wave-length limits 2155.72 A in the ultra-violet and 9250.27 in the infra-red. In this investigation an attempt has been made to improve upon an earlier description of these spectra.

An Experimental Study of the Corona Voltmeter. H. Brooks and F. Defandorf. B. of S. Jl. Res., Oct. 1928, pp. 589-633.

Whitehead's corona voltmeter (rating 140 kv effective voltage) was modified in order to improve control of pressure, temperature, and humidity. A new and highly accurate method of determining the 60-cycle crest voltage was used in studying the device, within a pressure range of three atmospheres and a temperature range of 15° to 45° C.

Production Time Measuring Devices (Betriebswirtschaftliche Zeitmessgeraete). H. Euler and H. Jordan. Archiv fuer Eisenhuettenwesen, Oct. 1928, pp. 261-282.

This article covers the types of instruments, prices, manufacturers and a bibliography.

Accelerated Laboratory Corrosion Test Methods for Zinc-Coated Steel. E. C. Groesbeck and W. A. Tucker, B. of S. Jl. Res., Aug. 1928, pp. 255-295.

The merits of two certain types of accelerated laboratory testing methods for evaluating the indicated life of the coating on hot-dip zinc-coated sheet steel were compared. The two methods studied were the simulated atmospheric corrosion, using a moist gaseous mixture of sulphur dioxide, carbon dioxide, and air, and the spray, using normal solutions of sodium chloride and ammonium chloride separately.

A Visual Method for Studying Modes of Vibration of Quartz Plates. A. Skellett, Jl. Opt. Soc., Oct. 1928, pp. 308-317.

A large number of beautiful patterns formed on the surface of a piezo-electric quartz plate by the glow discharge at low pressures of gas were observed at various radio frequencies of the exciting oscillator. They are caused by different modes of vibration of the plate of which there seems to be a great number. Evidence in support of the theory that the bright spots in the pattern occur at the antinodes of standing waves in the plate is presented from which it appears that the value of Young's modulus is the same for directions at angles of from 0 to 78 degrees from the optic axis. These patterns explain the multitude of frequencies at which a piezo-electric quartz plate will vibrate observed by Cady and others.

Quick Determination of Fatigue Strength (Die Schnellbestimmung der Dauerwechselfestigkeit). O. Bohuszewicz and W. Spaeth, Archiv Eisenhuettenwesen, Oct. 1928, pp. 249-255.

An instrument for quick static and dynamic torsion tests is described.

Practical Requirements Placed on Testing Machines (Anforderungen der Praxis an Pruefmaschinen). M. Moser, S. u. E., Sept. 27, 1928, pp. 1362-1372.

This article gives the basic requirements, mechanical and hydraulic drives, possibilities of power measurement, examples of suitable and unsuitable testing machine constructions, and critical consideration of the Universal machine.

Comparative Investigations of the Physical Properties of Cast Steel at Elevated Temperatures (Vergleichende Untersuchungen ueber die Festigkeitseigenschaften von Stahlguss bei erhohten temperaturen). A. Pomp, S. u. E., Sept. 20, 1928, pp. 1321-1330.

The article gives the results of physical tests made on 12 heats of steel from the open hearth, Bessemer and the electric furnace between the temperatures of 20 up to 500°C.

Aging Appearances in Thermocouples (Alterungserscheinungen bei Thermoelementen). W. Lent and F. Kofler. S. u. E., Oct. 18, 1928, pp. 1473-1474; also Archiv fuer Eisenhuettenwesen, Sept. 1928, pp. 173-176.

This article gives the results of investigating five different thermocouples: Chronin-Constantan, Chronin-Nickel as to thermoelectromotive force and mechanical stability when heating in furnace gases of coke plants blast furnace gas.

The Nigrometer, An Instrument for Measuring Blackness. C. R. Johnson, Paint, Oil & Chem. Rev., July 5, 1928, pp. 14-15.

An instrument is described which measures the blackness of surfaces with greater precision and dependability than can be done with the human eye.—Abs. Bull. Kodak Res. Labs.

The Use of Teleobjectives for Photomicrography. H. E. von Gronow. Phot. Korr., July 1, 1928, pp. 211-212.

A specific discussion of three types of teleobjectives—the Luminar, the Polar, and the Gronar—for use as micro-objectives.—Abs. Bull. Kodak Res. Labs.

The Measurement of Air Flow

By

E. OWER, B.Sc. (LOND.), HONS. I., A.C.G.I.

Bramwell Medallist; Member of the Institute of Heating and Ventilating Engineers; Assistant in the Aerodynamics Department, National Physical Laboratory.

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HOROLOGY—THE SCIENCE OF TIME MEASUREMENT AND THE CONSTRUCTION OF CLOCKS, WATCHES AND CHRONOMETERS. *J. Eric Haswell.* Chapman & Hall, Ltd., 1928. Cloth, 267 pages.

Review by M. Berg Rimbach on page 460 of October issue.

DIE TECHNIK ELEKTRISCHER MESSGERAETE. *Georg Keinath.* R. Oldenbourg, Germany, 1928, 3rd completely revised edition.

VOL. I: MEASURING INSTRUMENTS AND ACCESSORIES. Cloth, 620 pages. Price Postpaid $10.00.

VOL. II: MEASURING METHODS. Cloth, 424 pages. Price Postpaid $7.00.

VOLS. I & II Together Postpaid $15.00.

Review by M. Hartenheim on page 462 of October issue.

DIE GRUNDLAGEN DER DAMPFMESSUNG NACH DEM DIFFERENZDRUCKPRINZIP. *W. E. Germer.* R. Oldenbourg, 1927. Paper, 60 pages, 80c postpaid.

ANLEITUNG ZU GENAUEN TECHNISCHEN TEMPERATURMESSUNGEN. *O. Knoblauch and K. Hencky.* R. Oldenbourg, 1926. Cloth, 174 pages, $4.00 postpaid.

MATERIALPRUEFUNG UND BAUSTOFFKUNDE FUER DEN MASCHINENBAU. *W. Miller.* R. Oldenbourg, 1924. Cloth, 370 pages, $4.00 postpaid.

ELEKTRISCHE TEMPERATUR-MESSGERAETE. *Georg Keinath.* R. Oldenbourg, 1923. Cloth, 275 pages, $4.00 postpaid.

FEUCHTIGKEITSMESSUNG. *Herman Bongards.* R. Oldenbourg, 1926. Cloth, 322 pages, $5.00 postpaid.

DEHNUNGSMESSUNG AM LAUFENDEN RIEMEN. *Georg Steinmetz.* R. Oldenbourg, 1917. Paper, 20 pages, 50c postpaid.

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The Use of the Microscope in Heat Treatment. H. M. Boylston. Fuels & Fcse., Oct. 1928, pp. 1377-1382.

This article reviews the development made in the field of microscopic study in the last 36 years.

On the Effect of Temperature Changes Upon an Altimeter. T. Sasaki, K. Hattori, I. Hagiwara and R. Tate, Report No. 41, Aeronautical Research Institute, Tokyo Imperial University.

Tests were made on a number of altimeters and results given. Paper is printed in Japanese with an English abstract.

The Surging of Engine Valve Springs. Special Report No. 10, Department of Scientific and Industrial Research.

This report continues the series of accounts of the more important investigations of the Springs Research Committee appointed by the Department of Scientific and Industrial Research to consider the best materials and design for laminated and coil springs.

It is recognized that more detailed examination is desirable of the effect which surging may have in increasing the stresses in a spring, and thereby contributing to spring fractures, and means have been devised for recording the motions observed in a spring by the aid of stroboscopic illumination. A description of the apparatus designed for the purpose and the conclusions arrived at on the basis of the records obtained, form the subject of the report.

The Vibration Galvanometer Observed Stroboscopically. J. Saunders, Jl. Opt. Soc., Oct. 1928, pp. 326-327.

This article describes two methods of determining whether the settings of a vibration galvanometer used in the null method for measuring electrical quantities are too high or too low.

On the Measurement at Radio Frequency of the Conductivity of Liquids Without Immersed Electrodes. W. Powers and M. Dull, Jl. Opt. Soc., Oct. 1928, pp. 323-325.

This paper reports a method of testing the effects caused by small volumes of liquids when introduced within a small solenoid forming part of a triode circuit that is not a generator of oscillations.

Buyers' Guide

Instruments and accessories used for measurement, inspection or control in the industries and sciences.

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The Business Manager's Page

Each month the Business Manager will have a message on this page.

INSTRUMENTS offers a Better Instrument Service

"If a man preach a better sermon—write a better book or make a better mouse trap than his neighbor—though he build his house in the woods—the world will make a beaten path to his door." —*Emerson*

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Forest Products Laboratory, U. S. Department of Agriculture.

Please send information on the New Unimeter.

Wright Aeronautical Corporation.

On page 17 of the October issue of "INSTRUMENTS" there is a reference to a paper entitled "Research on Spring Steel." Please advise us as to where we can obtain a copy of this paper.

Hall Electric Heating Co., Inc.

Will you please furnish us the names of companies who manufacture recording water meters? Also the names of companies manufacturing planimeters.

American Gas & Electric Company.

We would appreciate information regarding the turbine steam meter.

The Timken-Detroit Axle Co.

As a subscriber to "Instruments" we would appreciate it very much if you could put us in touch with a company which manufactures reliable Tachometers which we can attach to our dynamometer.

The Northwestern Terra Cotta Co.

We are users of hydrometers and are anxious to standardize on a type of instrument satisfactory for our purpose in all of our factories. We would be very grateful if you could give us the accurate address of the manufacturers of the instrument described in this article.

Maxon Fibre Company.

We wish to thank you very much for your letter of May 26th relating to sources of information on instruments which we require.

Highland Glass Co.

We thank you for your reply to our letter of April 9th in regard to instruments for measuring roll temperatures.

Combustion Utilities Corporation.

We are particularly interested in flow meters useable at pressures over 1000 pounds per square inch, and so desire as complete description as possible of the specifications of instruments intended for such service.

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A brief biography.

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H. L. **HAZELTINE**, Instruments, Vol. 1, No. 11, November 1928, pp. 471-476, 6 figs.

The article briefly discusses flash point and describes the two methods of determination now in general use.

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E. S. **LINCOLN**, Instruments, Vol. 1, No. 11, November 1928, pp. 475-478, 4 figs.

Suggestions for the care and maintenance of portable electrical instruments are given in this article.

INTEGRATION OF DIAGRAMS FOR WHICH THE MOVEMENT OF THE PEN IS PROPORTIONAL TO THE "ORIFICE HEAD" BY MEANS OF ORDINARY "AREA-MEASURING" OR "RADIAL" PLANIMETERS.

JOHN L. **HODGSON**, M. Inst. Mech. E., Instruments, Vol. 1, No. 11, November 1928, pp. 479-482, 6 figs.

This article evaluates the error, involved by assuming that the mean flow is proportional to the square root of the mean head on the diagram, and a general rule is derived which enables one to see at a glance whether a diagram can be integrated directly by means of an ordinary planimeter, or whether it must first be replotted on a flow basis or integrated by means of a special square-rooting planimeter.

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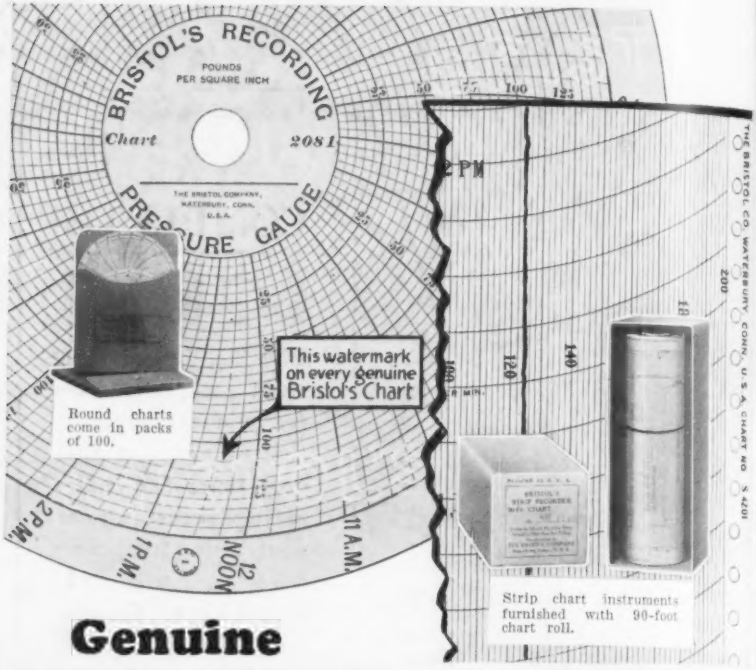

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